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TECHNICAL SERIES, No. 23.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY.
L. O. HOWARD, Entomologist and Chief of Bureau.

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MISCELLANEOUS PAPERS.

I. SOME NEW CALIFORNIA AND GEORGIA THYSANOPTERA.

By PAUL R. JONES, *Entomological Assistant, Deciduous Fruit Insect Investigations.*

II. AN INTERNAL PARASITE OF THYSANOPTERA.

By H. M. RUSSELL, *Entomological Assistant.*

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3.—*Phlœothrips armiger:* Left fore leg of male 20
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MISCELLANEOUS PAPERS.

SOME NEW CALIFORNIA AND GEORGIA THYSANOPTERA.

By Paul R. Jones,

Entomological Assistant, Deciduous Fruit Insect Investigations.

INTRODUCTION.

In the present paper Moulton's arrangement of genera has been followed and his key to North American species has been adapted to include the species herewith described. The numbers preceding the genera in the text agree with those in Moulton's paper,[1] to which the present article is supplemental, and will facilitate the use of these two publications.

4.[2] Genus ÆOLOTHRIPS Haliday.

Key to the Species.

1. Fore wings with dark cross-bands.
   - *a*. White band around abdominal segments 1 and 2; last four segments of antennæ much longer than fifth.
     - *b*. Segments 2 and 3 of abdomen white; wings with cross-veins. *Æolothrips bicolor* Hinds.
     - *b'*. Segments 1, 2, and posterior half of 3 white; wings without cross-veins. *Æolothrips vespiformis* Crawford.
   - *a'*. Without white band around first two abdominal segments; last four segments of antennæ approximately as long or a little longer than the fifth alone.
     - *b*. Last four segments of antennæ equal to the fifth alone, third segment one and one-third times as long as 1 and 2 together; wings with cross-veins. *Æolothrips fasciatus* Linnæus.
     - *b'*. Last four segments of antennæ one and one-fourth times as long as segment 5, segment 3 one and one-half times as long as 1 and 2 together; wings without cross-veins..... *Æolothrips nasturtii* new species.
2. Each fore wing with dark longitudinal band along posterior margin.
   - *a*. With veins in anterior wings normal as in most species of the genus. *Æolothrips kuwanaii* Moulton.
   - *a'*. Without veins in anterior wings..... *Æolothrips longiceps* Crawford.

Note.—In connection with the bureau's investigation of the pear thrips and the orange thrips in California during the past few years, it has appeared desirable to obtain as much information as possible on the characteristics, life histories, and food habits of related species of Thysanoptera, and as opportunity has offered observations on these insects have been made. In this way many species have been collected, some of which were found to be new to science. Mr. Moulton's paper[1] dealt with specimens obtained by him while connected with the investigation, and in the present paper Mr. Jones presents descriptions of several species which he has obtained in the course of his work during the past two years, and which have not heretofore been recognized.

A. L. Quaintance,
In Charge of Deciduous Fruit Insect Investigations.

[1] Tech. Ser. 21, Bur. Ent., U. S. Dept. Agr., 1911.

[2] The numbers preceding this and other genera are the same as those used by Moulton in his classification. (See Tech. Ser. 21, Bur. Ent., U. S. Dept. Agr.)

DESCRIPTION OF NEW SPECIES.

Æolothrips nasturtii new species. (Pl. I, figs. 1–4.)

Measurements: Head, length 0.25 mm., width 0.225 mm.; prothorax, length 0.2 mm., width 0.25 mm.; mesothorax, width 0.341 mm.; metathorax, width 0.266 mm.; abdomen, width at distal part of segment 1, 0.216 mm., width of segment 4, 0.483 mm. Antennæ: segment 1, 31μ; 2, 60μ; 3, 135μ; 4, 108μ; 5, 72μ; 6, 42μ; 7, 23μ; 8, 15μ; 9, 12μ; total length antennæ 0.50 mm. Total body length 2.10 mm.

Color uniform dark brown.

Head slightly longer than wide, sides parallel, *transversely striated above, covered with numerous small spines,* retracted within the prothorax, one spine on each outer side and one on each inner side of the antennæ near their base and *five on each side of the head. Eyes large, extending back well on the ventral side nearly one-half the length of the head,* coarsely faceted and *sparsely pilose. Ocelli* present, large, conspicuous, making an equilateral triangle, not situated far forward, the posterior ones contiguous with the inner margins of the eyes and slightly posterior to a line drawn through the middle of the eyes; four small spines on each side of the anterior ocellus. *Mouth-cone* long, bluntly rounded; maxillary palpi 3-segmented, basal joint large, apical very small. *Antennæ* 9-segmented, twice as long as the head, dark brown, concolorous with the rest of the body, except segment 2, which is light brown, and segment 3, which is lemon-yellow, shaded light brown at the tip; all segments thickly and uniformly clothed with short spines, those on segments 1 and 2 stouter; spines on segments 1, 2, 4, and 5 brown, on segment 3 and style white; sense cones inconspicuous; segment 3 one and one-half times as long as segments 1 and 2 together and more slender than the remaining segments.

Prothorax a little wider than long, only slightly larger than the head, slightly emarginate near the center on each side, clothed with a number of short spines above. *Mesothorax* largest, one and one-third times as wide as the prothorax, broadly rounded anteriorly. *Metathorax abruptly narrower than the mesothorax,* slightly wider than prothorax, edges parallel. *Legs* uniformly dark brown; front femora slightly thickened; tibiæ armed at the tip with two strong spines, those on hind tibiæ strongest; each fore-tarsus armed with a long, stout hook and a tooth; all the legs thickly set with small spines, giving them a pitted appearance. *Wings reaching to posterior margin of sixth abdominal segment,* broadly rounded at tip. No cross-veins present; two longitudinal veins uniting with ring-vein at tip; a *large* clear area at the base, *a similar clear area* a little past the middle, and a smaller area at the tip. *Right fore wing:* Anterior longitudinal vein, *one spine on distal part of basal clear area, five spines between*

basal and central clear areas, one spine on basal part and one on distal part of central clear area, four spines between central and apical clear areas, none on apical clear area; posterior longitudinal vein, *no spines on basal clear area, five spines between basal and central clear areas, one spine on basal and one on distal part of central clear area, five spines between central and apical clear areas, none on apical clear area. Left fore wing:* Anterior longitudinal vein, one spine on distal part of basal clear area, five spines between basal and central clear areas, none on central clear area, four spines between central and apical clear areas, last one on edge of apical clear area; posterior vein, no spines on basal clear area, four spines between basal and central clear areas, one spine on basal part and one on distal part of central clear area, five spines between central and apical clear areas, none on apical clear area. All spines on white areas nearly inconspicuous. *About 37 spines on anterior margin of fore wings,* nearly inconspicuous on the clear areas. Fore wings light brown except above-mentioned clear areas; microscopic hairs on dark areas brown, on clear areas white and inconspicuous; posterior margin with a long, simple fringe. Hind wings white; *anterior margin with a short, spine-like fringe;* posterior margin with a long, simple fringe.

Abdomen uniform brown, *elongate-ovate,* narrow at base, gradually *becoming wider until segment 4, which is equally as wide as the segments 5, 6, and 7,* gradually tapering from segment 7. Segments 1 to 8 without conspicuous hairs or spines except two short, curved spines on each side of segment 7, and two on each side of segment 8 near the posterior margin; segment 9 with a circlet of about eight long spines, several smaller spines near the posterior margin; segment 10 with a circlet of about six long spines near the middle; last three segments forming a sheath for the upturned ovipositor.

Described from one female specimen taken on flowers of watercress (*Nasturtium officinale*) at San Jose, Cal., May 23, 1910 (P. R. Jones).

Near *A. vespiformis* Crawford, but differing in the italicized characters.

7. Genus THRIPS Linnæus.

KEY TO THE SPECIES.

1. Head considerably wider than long.
   - *a.* Body color dark brown, thorax and other parts orange-tinted, inner crescents bordering ocelli orange-red. Individuals large, about 1.25 mm. in length.
     - *b.* Wings light brown, with lighter colored area near base. *Thrips madronii* Moulton.
     - *b'.* Wings uniform dark brown to brown..... *Thrips magnus* Moulton.

a'. Body color light yellow to light brown or brown, inner crescents bordering ocelli light brown; body length about 1 mm.

b. Ocelli subapproximate; posterior longitudinal vein of fore wing with about fourteen to seventeen regularly placed spines.

Thrips tabaci Lindeman.

b'. Ocelli widely separated, anterior one on front and directed forward; posterior longitudinal vein bearing about seven spines.

Thrips abdominalis Crawford.

2. Head about as long as wide.

a. Head much smaller than prothorax, one-half as wide as prothorax; fore femora and tibiæ greatly enlarged..... *Thrips femoralis* new species.

a'. Head only slightly smaller than prothorax, about five-sixths as wide as prothorax; fore femora and tibiæ only slightly enlarged.

b. Color uniform light lemon-yellow..... *Thrips bremnerii* Moulton.

b'. Color of head brown, thorax reddish orange-brown, abdomen pale yellow to gray-brown..... *Thrips perplexus* Beach.

DESCRIPTION OF NEW SPECIES.

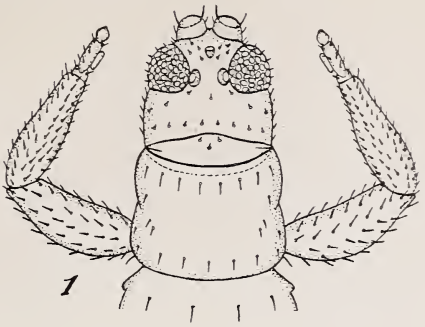
Thrips femoralis new species. (Pl. I, figs. 5–8.)

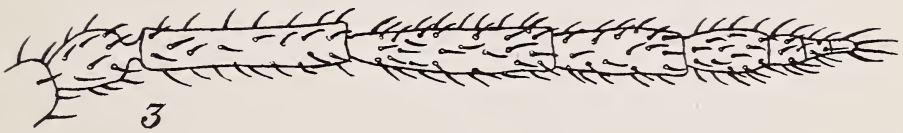
Measurements: Head, length 0.10 mm., width 0.108 mm.; prothorax, length 0.15 mm., width 0.216 mm.; mesothorax, width 0.266 mm.; abdomen, width 0.283 mm. Antennæ: Segment 1, 21μ; 2, 30μ; 3, 36μ; 4, 36μ; 5, 27μ; 6, 45μ; 7, 21μ; total length antennæ 0.216 mm. Total body length 1.31 mm.

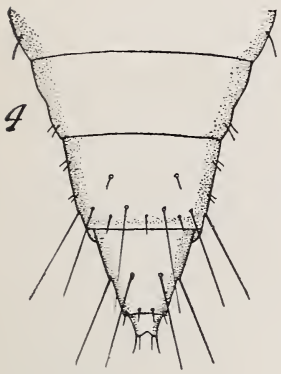
Color of body light grayish brown; head, prothorax, metathorax, and tip of abdomen darker.

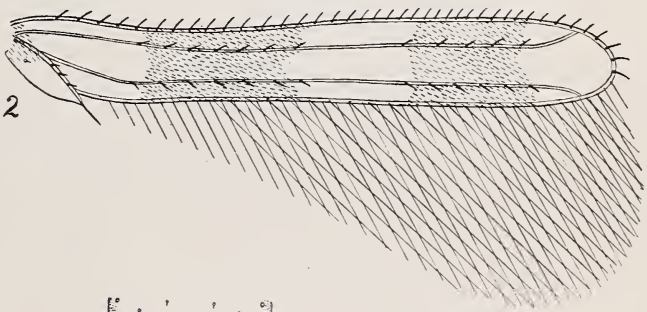
Head about as wide as long, very much smaller than prothorax, rounded in front, retracted slightly into prothorax; sides nearly straight; cheeks straight, not arched; back of head transversely striate. A small spine on each side of the anterior ocellus, and four behind each posterior ocellus. *Eyes* large, occupying more than two-thirds the width of head; facets large, inner row light colored, not protruding, sparsely pilose. *Ocelli* subapproximate, situated far backward, posterior ocelli nearly on level with the posterior margin of the eyes. Ocelli yellowish brown with dark-red crescents. *Mouth cone* long, reaching slightly past the middle of the prosternum; maxillary palpi 3-segmented; labial palpi 2-segmented. *Antennæ* 7-segmented, about two and one-tenth times as long as head, uniform light gray-brown except segment 3 and base of segments 4 and 5, which are lighter; base of segment 4 and segment 5 constricted into a broad handle, segment 3 into a longer, narrower handle; a forked sense-cone on the dorsal side of segment 3, one on the ventral side of segment 4, and a long simple sense cone on the lateral side of segment 6.

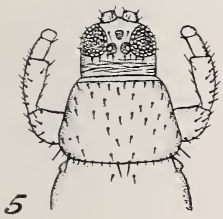
Prothorax very much larger than the head, one and one-half times as long and twice as wide, all angles rounded; two long spines on each posterior angle and two nearly as long on posterior margin near the

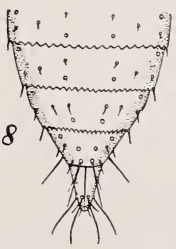


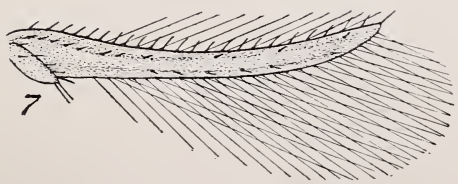












ÆOLOTHRIPS AND THRIPS.

Fig. 1.—*Æolothrips nasturtii:* Head and prothorax of female. Fig. 2.—*Æolothrips nasturtii:* Right forewing of female. Fig. 3.—*Æolothrips nasturtii:* Right antenna of female. Fig. 4.—*Æolothrips nasturtii:* End of abdomen of female. Fig. 5.—*Thrips femoralis:* Head and prothorax of female. Fig. 6.—*Thrips femoralis:* Left antenna of female. Fig. 7.—*Thrips femoralis:* Right forewing of female. Fig. 8.—*Thrips femoralis:* End of abdomen of female. Enlarged. (Original.)

middle; rest of posterior margin set with small spines and whole dorsum of prothorax with numerous slightly longer spines. *Mesothorax* largest, sides of *pterothorax* broadly rounded. *Legs* stout, fore femora and tibiæ greatly enlarged, remaining femora and tibiæ somewhat enlarged. Color of legs brown, fore tibiæ, tips of middle tibiæ, and fore and middle tarsi light yellowish brown. All tibiæ armed with spines. *Wings* present, fore wings large, uniform gray-brown, with spines arranged as follows: Costa with twenty-four; fore longitudinal vein with eight spines at base in groups of five, two, and one, with three scattered spines on apical half of wings; hind vein with six spines, the apical one separated from the rest. *Abdomen* stout, elongate-oval; segments 4, 5, and 6 largest; posterior margin of segments 1 to 7 with distinct sharp serrations, more distinct on apical segments; segment 8 with longer and sharper teeth. Almost no spines on abdomen except on last two anal segments. Segment 10 split above.

Described from two female specimens taken on goldenrod (*Solidago* sp.) at Barnesville, Ga., Aug. 22, 1910. (E. L. Jenne.)

11. Genus SERICOTHRIPS Haliday.

Key to the Species.

1. Wings fully developed or rudimentary.
   a. Wings fully developed.
      b. Fore wings white, no dark cross-bands or shading; general color white. *Sericothrips albus* new species.
      b′. Fore wings dusky or gray-brown and more or less distinctly marked with whitish cross-bands; general color yellowish dusky-gray. *Sericothrips variabilis* Beach.
      b″. Fore wings white, with gray cross-bands; head black; prothorax light yellow-brown; pterothorax black; tip of abdomen black; general color blackish..... *Sericothrips moultoni* new species.
      b‴. Fore wings black, with two broad white cross-bands and white at tip; head black; prothorax black; pterothorax somewhat lighter; general color blackish..... *Sericothrips pulchellus* Hood.
   a′. Wings reduced or fully developed; body dark brown to nearly black, except segments 4, 5, and 6 of abdomen, which are almost white. *Sericothrips cingulatus* Hinds.
2. Wings wanting.
   a. Body very dark brown, nearly black; pterothorax yellow to yellow-brown; legs brown..... *Sericothrips apteris* Daniel.
   a′. Body uniform brown; surface of body strongly reticulated; legs yellow. *Sericothrips reticulatus* Moulton.
   a″. Body and legs uniform brown; four stout spines on the dorsal side of segment 9. *Sericothrips stanfordii* Moulton.

DESCRIPTION OF NEW FORMS AND SPECIES.

Sericothrips apteris Daniel, male. (Pl. II, fig. 1.)

Length 1 mm. Similar to female except that it is usually lighter in color; legs light brown; usually the abdomen, except the last two segments, uniform dark brown; the basal two and the apical two segments sometimes light brown similar to the pterothorax. Segment 9 of abdomen with two very stout, bluntly-pointed, black spines upon the middle above, standing close together.

Described from five specimens collected on grass and weeds during March, April, and June, at San Jose, Cal. (P. R. Jones).

This is a very variable species and I have one specimen with the head dark brown and the remainder of the body uniform light brown.

Sericothrips albus new species. (Pl. II, figs. 2–5.)

Measurements: Head, length 0.1 mm., width 0.18 mm.; prothorax, length 0.13 mm., width 0.23 mm.; mesothorax, width 0.33 mm.; abdomen, length 0.78 mm., width 0.30 mm. Antennæ: Segment 1, 21 μ; 2, 36 μ; 3, 45 μ; 4, 45 μ; 5, 45 μ; 6, 57 μ; 7, 12 μ; 8, 18 μ; total length of antennæ 0.29 mm. Total body length 1.25 mm.

General color very pale, transparent white, devoid of any dark marking, except eyes, ocelli, mouthparts, apical joints of antennæ, and spot upon tarsi.

Head nearly twice as wide as long, retracted within the prothorax, considerably depressed in front where the antennæ are received; cheeks full, converging posteriorly. *Eyes* large, protruding a little, nearly black, coarsely faceted, pilose. *Ocelli* approximate, situated upon a slight raised area between the eyes, very light yellow, with dark reddish-brown crescents; posterior ocelli not contiguous with inner margins of eyes. Spines upon head inconspicuous, but one short, curved spine on each side of fore-ocellus, and two similarly curved spines across the front; sides with several short spines and a number of very small microscopic hairs. *Mouth-cone* very long, tipped with black, extending past posterior margin of prosternum a considerable distance upon the mesosternum. Maxillary palpi slender, three-segmented. *Antennæ* about three times as long as head, well separated by the projection of the head; segment 1 short and thick; segment 2 wider than 1; segments 3 and 4 fusiform; segment 5 fusiform at base, broad at apex where it joins segment 6; segment 6 tapering gradually from base with style to tip of antennæ. Color of antennæ pale transparent white except apex of segments 4 and 5, and segments 6, 7, and 8 which are entirely gray; a forked sense-cone on segments 3 and 4.

Prothorax slightly more than twice as wide as long, angles rounded, striated transversely upon dorsum; one short spine on each anterior angle, and one upon each posterior angle. *Pterothorax* large, about

one and one-half times as wide as prothorax, *mesothorax* slightly wider than *metathorax*. *Legs* everywhere transparent white, except dark spot near apex of each tarsus. *Wings* present, reaching to tip of abdomen, transparent white, similar to rest of body. About twenty-four to twenty-six spines upon the costa; about twenty-two on fore vein; one near base and one near apex of wing where hind veins should be. No fringe on anterior margin.

Abdomen cylindrical, tapering sharply from segment 8, thickly clothed with minute white hairs which appear as a fringe upon the posterior margins of the segments. Spines upon segments 1 to 8 weak and inconspicuous; a row of long white spines upon the dorsum of segment 9 near posterior margin, and a similar row on segment 10 near middle of dorsum.

Described from three females taken in May, 1910, at Visalia, Cal., from blossoms of elderberry (*Sambucus* sp.) and from weeds (P. R. Jones).

Structurally, this species is very close to *S. variabilis* Beach. It differs, however, in several details and shows such a constant difference in coloration that I believe it to be a good species.

Sericothrips moultoni new species, female. (Pl. II, figs. 6–9.)

Measurements: Head, length 0.1 mm., width 0.2 mm.; prothorax, length 0.166 mm., width 0.266 mm.; mesothorax, width 0.333 mm.; abdomen, length 0.90 mm., width 0.366 mm. Antennæ: Segment 1, 18 μ; 2, 45 μ; 3, 70 μ; 4, 60 μ; 5, 48 μ; 6, 54 μ; 7, 15 μ; 8, 18 μ; total length of antennæ 0.32 mm. Total length of body 1.35 mm.

Color dark brownish black. Similar to *S. variabilis* Beach, but differing from it as follows:

Head one-half as long as wide, uniformly brownish black. Segments 1, 2, and 3 of the antennæ very light yellowish brown; segments 4 and 5 apically, segments 6, 7, and 8 entirely, grayish brown; a pair of small spines near the inner and outer posterior margins of each eye.

Prothorax not concolorous with head, light yellowish brown, less than one-half as long as wide. *Pterothorax* brownish black, *mesothorax* slightly wider than *metathorax*. Posterior femora uniformly dark brown, except an area at the base. *Fore wings* transparent white, except a small grayish-brown area at base, and one cross-band of similar color about one-third the distance of the wing from the base. About twenty-six spines on costa; about twenty-two spines on fore vein; usually no spines where hind vein should be, but sometimes one spine present near apex of wing.

Abdomen: Segments 1, 2, 7, 8, 9, and 10 brownish black; intermediate segments light yellowish-brown with the anterior margins brownish black, varying in extent. Segments clothed with numerous fine hairs, appearing as a fringe on the posterior margins. Segment

2 often, 7 usually about one-half as long as the remaining segments of the abdomen.

Male: Length about 1.08 mm.; coloration similar to that of female.

Described from numerous specimens, both male and female.

Living specimens, when viewed under a hand lens, appear to be velvety black upon the *head, pterothorax,* and *tip of the abdomen.*

This species was very abundant in 1910, from April to October, upon one plant of a large perennial lupine near San Jose, Cal., and is very active in flying and leaping (P. R. Jones).

The larvæ were abundant also and these, together with the adults, were so numerous as to completely ruin the foliage of the above plant. Very few specimens were in the flowers.

Named for Mr. Dudley Moulton in recognition of his very valuable work on American Thysanoptera.

13. Genus LIMOTHRIPS Haliday.

KEY TO THE SPECIES.

1. Segment 2 of antennæ drawn out into a prominent, acute, triangular process on the outer angle ..... *Limothrips setariæ* new species.
2. Segment 2 of the antennæ simple ..... *Limothrips cerealium* Haliday. (Synonym, *L. avenæ* Hinds.)

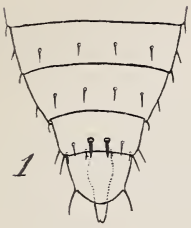
DESCRIPTION OF NEW SPECIES.

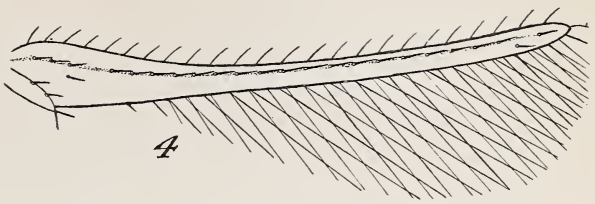
Limothrips setariæ new species, female. (Pl. III, figs. 1–5.)

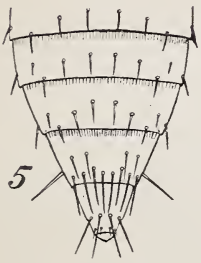
Measurements: Head, length 0.216 mm., width at eyes 0.166 mm., width at back of head 0.2 mm.; prothorax, length 0.183 mm., width 0.233 mm.; mesothorax, width 0.333 mm.; abdomen, width 0.35 mm.; total length of body 2.116 mm. Antennæ: Segment 1, 18μ; 2, 45μ; 3, 51μ; 4, 45μ; 5, 48μ; 6, 60μ; 7, 12μ; 8, 18μ; total length of antennæ 0.30 mm.

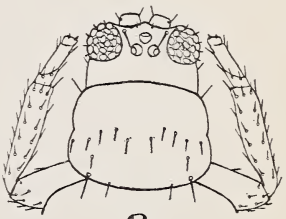
Color dark yellowish brown, ends of tibiæ and tarsi lighter.

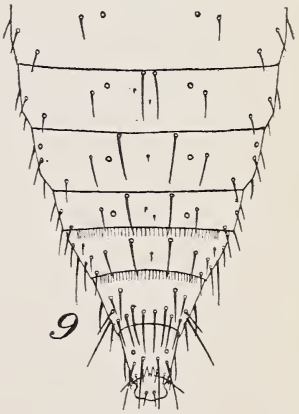
Head slightly longer than wide, diverging posteriorly; cheeks very slightly arched; back of head scarcely striated at all; a pair of spines in front of anterior ocellus, one in front of each posterior ocellus, one posterior to each eye, and a row of four spines midway between base of eyes and posterior margin. Front strongly produced anteriorly, considerably so between the bases of the antennæ. *Eyes* moderately prominent, black, with yellow borders, protruding slightly, coarsely faceted, not pilose. *Ocelli* well separated, anterior one smallest, posterior ones contiguous with inner margins of the eyes; brownish yellow, with dark-brown crescents; not situated far forward. *Mouth-cone* obtusely pointed, extending past middle of prosternum; maxillary palpi short, 3-segmented. *Antennæ* 8-segmented, about one and one-half times as long as the head, slender, uniformly dark brown except segments 2, 3, and 4, which are slightly lighter. Segment 1 very short and thick; 2 *large, drawn out into an acute triangular*

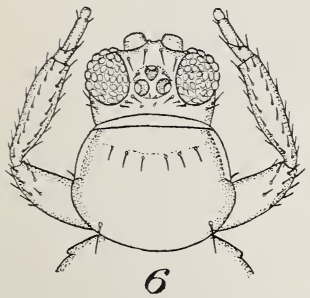


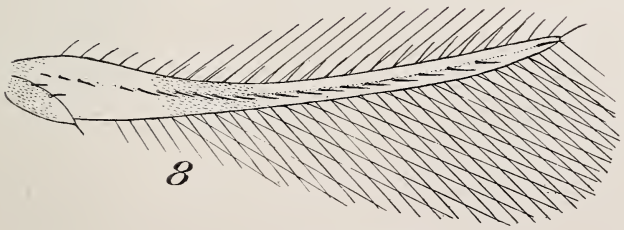






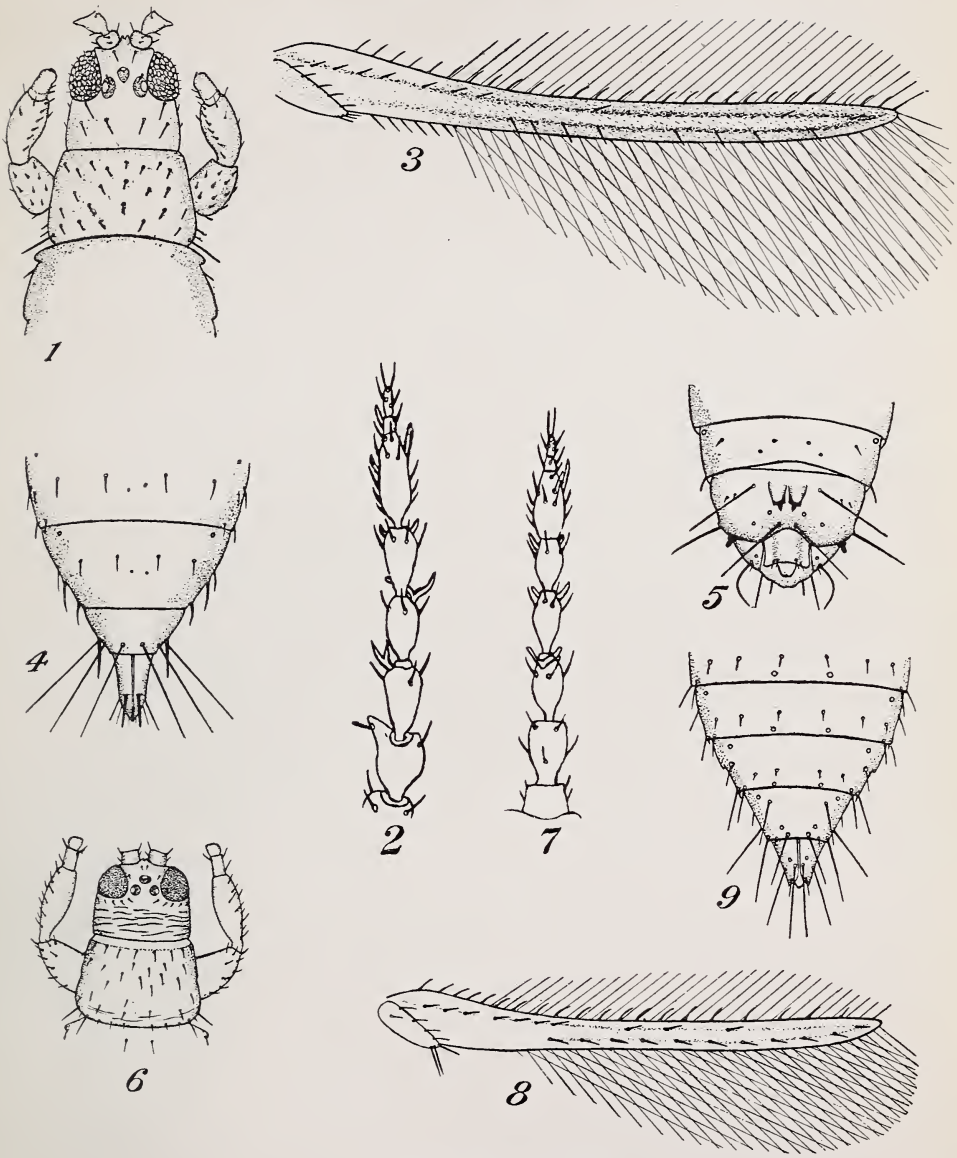






SERICOTHRIPS.

Fig. 1.—*Sericothrips apteris:* End of abdomen of male. Fig. 2.—*Sericothrips albus:* Head and prothorax of female. Fig. 3.—*Sericothrips albus:* Right antenna of female. Fig. 4.—*Sericothrips albus:* Right forewing of female. Fig. 5.—*Sericothrips albus:* End of abdomen of female. Fig. 6.—*Sericothrips moultoni:* Head and prothorax of female. Fig. 7.—*Sericothrips moultoni:* Right antenna of female. Fig. 8.—*Sericothrips moultoni:* Right forewing of female. Fig. 9.—*Sericothrips moultoni:* End of abdomen of female. Enlarged. (Original.)



LIMOTHRIPS AND EUTHRIPS.

Fig. 1.—*Limothrips setariæ:* Head and prothorax of female. Fig. 2.—*Limothrips setariæ:* Left antenna of female. Fig. 3.—*Limothrips setariæ:* Right forewing of female. Fig. 4.—*Limothrips setariæ:* End of abdomen of female. Fig. 5.—*Limothrips setariæ:* End of abdomen of male. Fig. 6.—*Euthrips longirostrum:* Head and prothorax of female. Fig. 7.—*Euthrips longirostrum:* Left antenna of female. Fig. 8. *Euthrips longirostrum:* Right forewing of female. Fig. 9.—*Euthrips longirostrum:* End of abdomen of female. Enlarged. (Original.)

process at the outer angle; 3 and 4 fusiform; 5 clavate; 6 fusiform; 7 and 8 slender, cylindrical. A forked sense cone on outer side of segment 3, a similar one on inner side of segment 4, and similar ones on ventral side of segments 5 and 6; all other sense cones simple, short, slender, and inconspicuous.

Prothorax a little shorter than the head, one and one-third times wider than long, diverging from the head posteriorly; one prominent spine on each posterior angle, the other spines short and inconspicuous; sides slightly rounded. *Mesothorax nearly twice as wide as the prothorax; metathorax* abruptly narrower. *Legs* uniform brown, except fore tibiæ, ends of tibiæ, and tarsi, which are brownish yellow; legs moderately long, hind tibiæ alone bearing a fringe of stout spines. *Wings* present, long and slender, *about fifteen times as long as the width in the middle.* Two longitudinal veins in fore wing, branching at about one-fourth its length. Both veins and costa bearing a few short dark brown spines; *costa with about twenty-five to twenty-eight; fore veins with about ten, only three beyond the middle; hind vein with eight more or less regularly placed spines.* Fore wings dark smoky gray; hind wings slightly gray; costal fringes long and prominent.

Abdomen about two-thirds length of body, about as wide as long. Spines on abdomen weak and inconspicuous before segment 7; segment 8 bearing on each side three or four stout, curved, dark-brown spines; segment 9 bearing a circlet of long slender spines and *two very stout spines, one on each latero-posterior edge on the dorsum just in advance of the circlet of spines.* Segment 10 split open above, sharply pointed, and on each side above with a short, very stout, straight, dark-brown spine, reaching slightly beyond the tip. Abdomen yellowish brown, darker toward tip, connective tissue pale yellow.

Described from numerous long-winged females taken on green foxtail grass (*Setaria viridis*), wild oats, and California buckeye (*Æsculus californica*), San Jose, Cal., June-July, 1910 (P. R. Jones).

Near *Limothrips avenæ* Hinds (=*cerealium* Haliday, according to Bagnall) but differing in the italicized characters.

Male: Head, length 0.116 mm., width 0.2 mm.; antennæ, length 0.258 mm.; prothorax, length 0.166 mm.; prothorax, width 0.25 mm.; mesothorax, width 0.175 mm.; abdomen, width 0.341 mm.; total length 1.366 mm.

Color brownish yellow, head grayish brown. Head one and one-half times as wide as long, ocelli wanting, only vestiges remaining in some specimens. *Mouth-cone* longer than in female, extending nearly to posterior margin of the prosternum. *Antennæ* stout, a little more than twice as long as the head, process on second joint not so acute as in the female. *Prothorax* a little longer than the head, one and one-third times as broad as long. No vestiges of wings. *Abdomen* about two and one-half times as long as broad, bluntly rounded;

segment 9 large, bluntly conical; segment 10 small, retracted within 9. Close together on the middle of the dorsum of segment 9 stand two short, very stout spines borne upon broader, black, chitinous projections, the inner and outer edges of which are parallel; on each side of the projections is a long, slender spine; on the latero-posterior edge of segment 9 on each side is another chitinous, black projection supporting a stout, black spine; a much longer, slender, curved spine on each side of segment 9 about one-fourth of the distance from the posterior margin; two long, slender spines projecting on each side of segment 10 from underneath. Segment 9 cut out above over about one-half of segment 10.

Described from six specimens.

18. Genus EUTHRIPS Targioni-Tozzeti.

KEY TO THE SPECIES.

1. Without prominent spines on fore-angles of prothorax, longitudinal veins not regularly set with spines.
   a. Head noticeably wider than long; general color white to light yellow or orange.
      b. Last two segments of antennæ rather long and slender, and together about two-thirds as long as segment 6; wings shaded brown, with transparent whitish areas near base and at tip; ring-vein and longitudinal veins not conspicuous.
      Euthrips orchidii Moulton.
      b'. Last two segements of antennæ not noticeably elongate and slender and together about one-half as long as segment 6.
         c. Ring-vein and at least part of fore-vein conspicuous.
            d. Body color translucent white to yellowish white; spines on costa of fore-wings unusually long; ring vein and both longitudinal veins conspicuous; segments 3 and 4 of antennæ pedicellate; wings shaded dilute yellow.
            Euthrips costalis new species.
            d'. Body color orange-yellow; spines on costa of fore-wings not unusually long; segements 3 and 4 of antennæ not pedicellate.
               e. Wings shaded brown, fore-part of longitudinal vein alone conspicuous.....*Euthrips longipennis* Bagnall.
               e'. Wings not shaded brown; both longitudinal veins present, with three or four scattered spines on each, one of which stands at the abrupt ending of each vein.
               Euthrips citri Moulton.
         c'. Ring vein and longitudinal veins not conspicuous; group of six spines on basal part of wing where anterior vein should be and nine on outer half where posterior vein should be; color of body and wings clear white, outer half of antennæ dark brown.....*Euthrips albus* Moulton.
   a'. Head about as long as wide or a little wider (except *Euthrips longirostrum*, which is noticeably wider than long); general color brown, thorax sometimes orange-brown and yellow-brown.
      b. Eyes pilose; no postocular spines; two long, prominent spines between posterior ocelli; segments 3 and 4 of antennæ not pedicellate; fore-wings with transparent area near base; hind longitudinal vein of fore-wings with about sixteen spines.
      Euthrips pyri Daniel.

b'. Eyes not pilose; postocular spines present; a prominent spine in front of each posterior ocellus, segments 3 and 4 of antennæ not pedicellate; fore-wings without transparent area near base; hind longitudinal vein of fore-wings with about thirteen spines.....*Euthrips ehrhornii* Moulton.

b''. Eyes not pilose; postocular spines absent; no prominent spines in front of or between posterior ocelli; segments 3 and 4 of antennæ pedicellate; fore-wings without transparent area near base; hind longitudinal vein of fore-wings with about ten spines; mouth-cone very long...*Euthrips longirostrum* new species.

2. With spines on fore-angle of prothorax; longitudinal veins on fore-wings set regularly with spines.

a. Fore tibiæ armed at end with tooth. Females dark brown, wings brown with whitened area near base; antennæ concolorous with head except segment 3, which is light yellow.
Euthrips ulicis californicus Moulton.

a'. Fore tibiæ not armed with tooth.

b. Postocular spines wanting; row of spines along anterior margin of prothorax either wanting or at least not conspicuous except often the third from the outer margin.

c. Antennæ uniformly brown to dark brown, concolorous with body; wings light yellow-brown, veins prominent; spines brown, twenty-three on fore vein, sixteen on hind vein, short and moderately stout; white longitudinal area near base of wing.
Euthrips minutus Moulton.

c'. Antennæ with segment 3 yellowish; segments 3 and 4 light gray-brown, yellowish at base; wings gray-brown, veins not prominent, spines on wings normally long and stout, fourteen on fore vein, ten on hind vein (wings may be reduced to pads).....*Euthrips fuscus* Hinds.

b'. Postocular spines conspicuous.

(1.) General color uniformly brown to dark brown, no shading of orange. Antennæ with segments 3, 4, and 5 light brown to yellow and shaded.

a. Uniformly dark brown, fore-wings shaded dark brown, with a large whitened area extending across wing near base; spines on wings all dark brown.....*Euthrips insularis* Franklin.

a'. Color yellowish brown, fore-wings uniformly shaded with gray.
Euthrips nervosus Uzel.

(2.) General color whitish to yellow or yellowish to brown, no shading of orange.

a. Segment 2 of antennæ with a double spine-bearing tubercule; vertex of head depressed and anterior ocellus directed forward.

b. Color uniformly yellow, surface of body without reticulation.
Euthrips cephalicus Crawford.

b'. Color uniformly brown; surface of body reticulated.
Euthrips cephalicus var. *reticulatus* Crawford.

a'. Segment 2 of antennæ without double spine-bearing tubercule; vertex of head not depressed; anterior ocellus directed upward; color yellowish shaded with dusky brown.
Euthrips helianthi Moulton.

(3.) General color light yellow to yellowish brown, thorax or other parts decidedly tinted with orange.

a. Head pale lemon-yellow to light yellowish brown; thorax orange-yellow; abdomen brownish yellow to brown; segement 1 of antennæ whitish to light brown; segment 2 dark brown. *Euthrips occidentalis* Pergande.

a'. General color brownish yellow, not uniform, thorax orange yellow, segment 1 of antenna pale yellow, 2 light brown, base sometimes yellowish.....*Euthrips tritici* Fitch.

a''. General color brown to dark brown, thorax orange-brown. *Euthrips tritici* var. *californicus* Moulton.

DESCRIPTION OF NEW FORMS AND SPECIES.

Euthrips ehrhornii Moulton, male.

Measurements: Head, length 0.15 mm., width 0.2 mm.; prothorax, length 0.166 mm., width 0.183 mm.; mesothorax, width 0.2 mm.; abdomen, width 0.25 mm.; total body length 1.4 mm.

General color similar to female, light brown, head lighter than rest of body.

Antennæ light gray-brown; segments 1 and 3, base and apex of segment 4, and apex of segment 5, brownish white. *Legs* very light brown, trochanters and underside of all the legs nearly white. *Wings* fully developed, nearly transparent white, lightly tinged with grayish-brown; veins weak; spines on wings not so prominent as in the female, arranged as those in female except that there are five on scale of wing and four scattering spines on distal part of fore vein.

Described from one male taken April 9, 1910, from flowers of large, bushy perennial lupine at San Jose, Cal. (P. R. Jones).

Female, *forma brachyptera:* Similar to *forma macroptera* except larger and longer (1.9 mm. in length); general color darker brown, head not lighter; antennæ similar in color to rest of body, apex of segments 3, 4, and 5, white; head longer than wide, a row of spines on head across the front; wings short, extending to base of abdomen; trochanters similar in color to rest of body; abdomen large in proportion to rest of body, segment 10 split above.

Described from two brachypterous females taken from wild flowers March 31, 1910, at San Jose, Cal. (P. R. Jones).

This species is very close to *Euthrips pyri* Daniel, and is evidently quite variable.

Euthrips longirostrum new species. (Pl. III, figs. 6–9.)

Measurements: Head, length 0.10 mm., width 0.133 mm.; prothorax, length 0.15 mm., width 0.183 mm.; mesothorax, width 0.25 mm.; abdomen, width 0.30 mm. Antennæ: Segment 1, 24μ; 2, 42μ; 3, 48μ; 4, 48μ; 5, 36μ; 6, 48μ; 7, 11μ, 8, 15μ; total length of antennæ 0.267 mm. Total body length 1.08–1.40 mm.

Color of body, brown; head, thorax, legs, and antennæ tinged with yellow.

Head about one and one-third times as wide as long, rounded in front, retracted considerably within the prothorax; cheeks slightly arched; back of head transversely striate, bearing five small spines in a row posterior to each eye; also one on each side and two in front of anterior ocellus. *Eyes* prominent, oval in outline, black, with light borders, finely faceted, not pilose. *Ocelli* subapproximate, light yellow, with reddish brown crescents. *Mouth-cone* very long, pointed, *reaching to middle of mesosternum*, tipped with black; maxillary palpi large, long, 3-segmented, middle segment shortest; labial palpi 2-segmented. *Antennæ* 8-segmented, nearly two and four-fifths times as long as head, uniform light-yellowish gray-brown, except segments 1 and 3, which are lighter, and apex and base of segment 3 broadly, base of segment 4, and segment 5, which are transparent white; segment 3 with a distinct handle, segments 2, 4, and 5 constricted somewhat at the base; a forked sense-cone on dorsal side of segment 3, a similar one on ventral side of segment 4, a short, simple sense-cone on lateral side of segment 5, near apex; spines pale brown.

Prothorax slightly wider than long, one and one-half times as long as head; a very small, weak spine at each anterior angle, two strong ones at each posterior angle, a row of short spines on the posterior margin, and a number on the dorsum. *Mesothorax* largest, angles rounded. *Legs* long, lighter than body, dilute yellowish gray-brown, femora darker; in some specimens the legs are yellowish-white, hind femora darker. Spines at tip of fore and middle tibiæ weak; several strong spines at apex of hind tibiæ. *Wings* present, yellowish-white. Veins usually indistinct and tending to disintegrate in mounted specimens. Wings sometimes extending past tip of abdomen, but usually shorter in proportion to abdomen. Spines arranged as follows: Costa with 21 spines, fore longitudinal vein with eleven spines, seven on basal half of wing, three in one group, four in the other, and four scattered spines on apical half, one of which is near apex; hind longitudinal vein with ten regularly placed spines beginning where basal group ends on fore longitudinal vein.

Abdomen subovate, tapering quite suddenly from segment 7. A number of long, stout spines on last three segments. Last segment split above on dorsum.

Described from four females taken from flowers of a perennial lupine, Los Gatos, Cal., May, 1910 (P. R. Jones). Male unknown.

Euthrips costalis new species. (Pl. IV, figs. 1–4.)

Measurements: Head, length 0.10 mm., width 0.166 mm.; prothorax, length 0.11 mm., width 0.183 mm.; mesothorax, width 0.283 mm.; abdomen, width 0.316 mm. Antennæ: Segment 1, 27 μ; 2, 36 μ; 3, 48 μ; 4, 45 μ; 5, 36 μ; 6, 51 μ; 7, 9 μ; 8, 12 μ; total length of antennæ 0.264 mm. Total body length 1.33 mm.

Color of body very dilute yellowish-white, segments 4 to 8 of antennæ grayish brown.

Head angular in front, depressed to receive basal segments of antennæ; sides straight, about one and one-third times as wide as long; spines on head inconspicuous, except one on inner side of each posterior ocellus. *Eyes* large, black, not protruding, slightly pilose; facets large. *Ocelli* approximate, yellow, with brownish-red crescents. *Mouth-cone* short, blunt, tipped with black; maxillary palpi 3-segmented; labial palpi 2-segmented. *Antennæ* 8-segmented, slender, about two and three-fifths times as long as the head; segments 3 and 4 distinctly constricted into a handle at the base. Color of segments 1, 2, and 3 white, faintly tinged with yellow, outer half of segment 3 darker; remaining segments grayish brown, except apices, which are transparent white. A forked sense-cone on dorsal side of segment 3, a similar one on ventral side of segment 4, and two simple sense-cones on each side of segments 5 and 6, near apex. Spines pale and inconspicuous.

Prothorax only a little wider than the head, constricted in the middle; two long, prominent spines on each posterior angle, no visible spines on posterior margin, but four or five short, slender, inconspicuous spines on lateral margins extending to anterior angles. *Mesothorax* largest, sides of *pterothorax* broadly and evenly rounded. *Legs* long and slender, concolorous with body, very light yellowish-white; spines on hind tibiæ alone visible. *Wings* present; forewings broadest at basal third, pointed at ends, all veins conspicuous to end of wings. Spines arranged as follows: *Costa with about eighteen very long, strong spines, much longer than is usual in this genus;* fore longitudinal vein with eight spines, six at base and two at apex; hind longitudinal vein with eight regularly placed spines, beginning where basal group on fore vein ends; anterior fringe very light; posterior fringe long; both fringes present only on apical half of wing. Wings concolorous with body, very light yellowish white.

Abdomen long and slender; spines conspicuous only on last two segments; a comblike arrangement on posterior margin of segment 8.

Described from one female specimen from flowers of California buckeye (*Æsculus californica*), June 6, 1910, San Jose, Cal. (P. R. Jones.) Male unknown.

19. Genus ANAPHOTHRIPS Uzel.

KEY TO THE SPECIES.

1. Antennæ 9-segmented; no spines on posterior angles of prothorax; cheeks straight; surface of abdomen not faintly cross-striated; crescents of ocelli bright orange-yellow; species apparently not saltatory.
   Anaphothrips obscurus Müll. (Synonym, *A. striatus* Osborn.)
2. Antennæ 9-segmented; one stout spine on each posterior angle of prothorax; cheeks arched; crescents of ocelli light brown; species apparently not saltatory.

a. Head about as long as wide; wings not unusually long, shaded gray-brown, with small transparent area near base; segments 5, 6, 7, and 8 of abdomen without comblike arrangement of spines along posterior margin; color uniform yellow to gray-brown; segment 3 of antennæ not pedicellate.
Anaphothrips zeæ Moulton.

a'. Head noticeably wider than long; wings not unusually long, transparent; segments 5, 6, 7, and 8 of abdomen with conspicuous comblike arrangement of spines; color of head and prothorax yellowish or orange-yellow, abdomen brown; segment 3 of antennæ pedicellate.
Anaphothrips tricolor Moulton.

a''. Head noticeably wider than long; wings very long, light brown, with clear area near base; abdominal segments without comblike arrangement of spines on posterior margin of abdominal segments; color brownish yellow to yellowish white; segment 3 of antennæ pedicellate.
Anaphothrips longipennis Crawford.

3. Antennæ with 8 segments; one stout spine on each posterior angle of prothorax; head noticeably wider than long; species saltatory.

a. Color uniform yellow; first longitudinal vein with ten or eleven spines, hind longitudinal vein with three spines; ocelli subapproximate, with reddish-orange crescents; ovipositor extending past tip of abdomen; segment 3 of antennæ pedicellate....(*Scirtothrips*) *Anaphothrips ruthveni* Shull.

a'. Color translucent white, tinged yellowish brown; first longitudinal vein with nine spines, second longitudinal vein with two; ocelli approximate, crescents light brown; ovipositor not extending past tip of abdomen; segment 3 of antennæ not pedicellate..*Anaphothrips albus* new species.

The genus *Scirtothrips* was erected by Shull[1] for the species *ruthveni* on the characters "*Head is shorter than broad and shorter than prothorax, one spine of moderate length is borne by each posterior angle of the prothorax. Species of this genus have the power of springing.*"

Since then *Anaphothrips zeæ*, *A. tricolor*, and *A. longipennis* have been described and now *A. albus*, all of which have long spines on the posterior angles of the prothorax. In *A. tricolor*, *A. longipennis*, and *A. albus* the head is also noticeably wider than long, while *A. albus* possesses the power of springing; the latter also does not have an oblique division of segment 6 of the antennæ. I am positive that the last four species belong to the genus *Anaphothrips*, and if such is the case the genus *Scirtothrips* can not hold upon the characters for which it was erected.

DESCRIPTION OF NEW FORMS AND SPECIES.

Anaphothrips zeæ Moulton.

Female, *Forma brachyptera:* Length 1.53 mm. Similar to *Forma macroptera* except that it is longer and the abdomen, which is larger in proportion to the rest of the body, is much wider than the pterothorax.

Described from two specimens taken on weeds, May 21, 1910, at Visalia, Cal. (P. R. Jones).

This form of *Anaphothrips zeæ* resembles *Aptinothrips rufus* (Gmelin) superficially.

[1] Ent. News, vol 20, no. 5, p. 222, 1909.

Male: Length 1.16 mm. Similar to female, but more slender in form; antennæ one and one-half times as long as the head, more slender than in the female. Spines on wings as follows: Fore vein with a group of four regularly placed spines near the base, a second group of seven regularly placed spines, a group of two slightly distad of the middle, and two widely separated spines on the outer half; hind vein with ten more or less regularly placed spines.

Genitalia and orange-colored testes very prominent.

One specimen, taken May 21, 1910, on weeds at Visalia, Cal. (P. R. Jones).

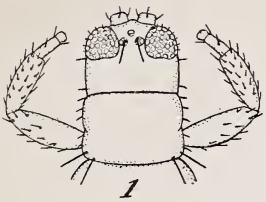
Anaphothrips albus new species. (Pl. IV, figs. 5–8.)

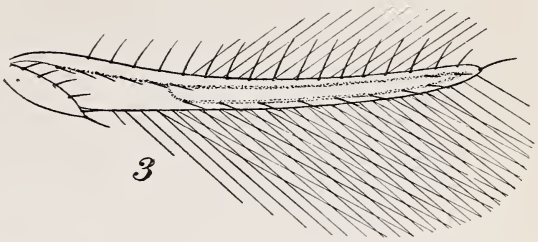
Measurements: Head, length 0.10 mm., width 0.133 mm.; prothorax, length 0.10 mm., width 0.15 mm.; mesothorax, width 0.183 mm.; abdomen, width 0.233 mm. Antennæ: Segment 1, 18μ; 2, 33μ; 3, 45μ; 4, 42μ; 5, 36μ; 6, 42μ; 7, 9μ; 8, 12μ; total length of antennæ 0.247 mm. Total length of body 1 mm.

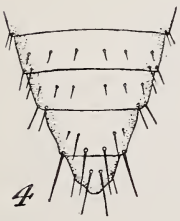
Color of body translucent white, tinged very lightly with yellowish brown, varying sometimes; head and thorax slightly darker. *Head* considerably broader than long, rectangular, without visible spines, slightly angular in front; cheeks arched. *Eyes* black, prominent, protruding, with coarse facets. *Ocelli* present, approximate, nearly contiguous; crescents light brown. *Mouth-cone* long, broad at base, pointed at tip, which is black, extending to base of prosternum. Maxillary palpi large, 3-segmented; labial palpi 2-segmented, basal segment long. *Antennæ* long, about two and one-half times as long as head, slender, 8-segmented, no oblique line dividing sixth segment; color of segments 1 and 2 very light transparent yellowish white, segment 3 lighter, apex of segment 4, apical half of segment 5, and remaining segments entirely shaded lightly with gray; a forked sense-cone in ventral side of segment 5, and a simple sense-cone on apex of segments 3, 4, 6, and 7, on lateral side.

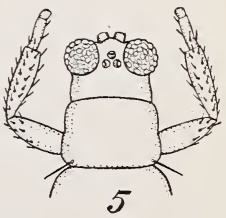
Prothorax as long as head and only slightly wider; one long, slender, transparent, nearly inconspicuous spine on each posterior angle, no other spines visible. *Mesothorax* largest, sides rounded. *Metathorax* with sides almost parallel but constricted abruptly behind. *Legs* concolorous with body but slightly lighter, hind tibiæ alone armed with spines. *Wings* present, uniformly transparent white, barely discernible. Costa with twenty-six spines; fore longitudinal vein with six spines on basal half in groups of three, then three scattered ones; apical half of wing with three widely scattered spines; hind longitudinal vein with only two widely separated spines on apical half of wing. Anterior fringe very weak, both anterior and posterior fringes not beginning until about the middle of the wing.

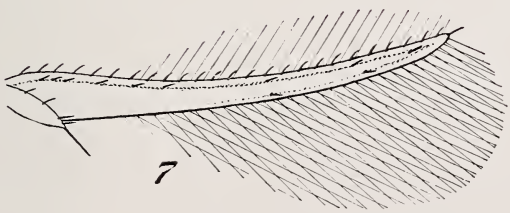
Abdomen subovate, lighter translucent white than rest of body, without pronounced spines except on terminal segments, all spines

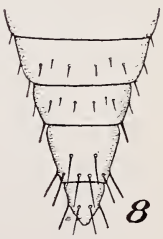












EUTHRIPS AND ANAPHOTHRIPS.

Fig. 1.—*Euthrips costalis:* Head and prothorax of female. Fig. 2.—*Euthrips costalis:* Right antenna of female. Fig. 3.—*Euthrips costalis:* Right forewing of female. Fig. 4.—*Euthrips costalis:* End of abdomen of female. Fig. 5.—*Anaphothrips albus:* Head and prothorax of female. Fig. 6.—*Anaphothrips albus:* Right antenna of female. Fig. 7.—*Anaphothrips albus:* Right forewing of female. Fig. 8.—*Anaphothrips albus:* End of abdomen of female. Enlarged. (Original.)

transparent. One specimen is more deeply tinged with yellowish brown.

Male: Length 0.833 mm. Smaller and more slender than female but similar in color; orange-colored testes prominent.

Described from two female and one male taken from monkey flower (*Mimulus* sp.) June 6, 1910, San Jose, Cal. (P. R. Jones).

Living specimens are very white and fly readily; they also have the power of springing.

24. Genus ANTHOTHRIPS Uzel.

Key to the Species.

1. Postocular spines wanting; antennæ almost uniformly brown except segment 2 and base of segment 4, which are light brown..*Anthothrips niger* Osborn.
2. Postocular spines well developed.
   - *a*. Postocular spines and most of the spines on postero-lateral margin of abdominal segments knobbed.....*Anthothrips flavipes* new species.
   - *a'*. Postocular spines and spines on postero-lateral margin of abdominal segments not knobbed.
     - *b*. Antennæ uniformly brownish black; apex of femora with a small, anteriorly-directed, triangular tooth within..*Anthothrips nigricornis* new species.
     - *b'*. Segments 3 and 6 of antennæ, eyes, fore tibiæ, all tarsi, and other lighter parts of body shaded with orange yellow; femora without tooth at apex.....*Anthothrips verbasci* Osborn.
     - *b''*. Intermediate segments of antennæ and other light parts of body light brown; femora without tooth at apex..*Anthothrips variabilis* Crawford.

DESCRIPTION OF NEW SPECIES.

Anthothrips nigricornis new species. (Pl. V, figs. 1–4.)

Measurements: Head, length 0.30 mm., width 0.283 mm.; prothorax, length 0.233 mm., width 0.416 mm.; mesothorax, width 0.483 mm.; abdomen, width 0.536 mm.; length of tube 0.15 mm.; total length of body 2.383 mm. Antennæ: Segment 1, 30μ; 2, 48μ; 3, 51μ; 4, 63μ; 5, 60μ; 6, 51μ; 7, 48μ; 8, 30μ; total length of antennæ, 0.381 mm.

General color very dark brown to black with purplish pigmentation.

Head about as long as wide; cheeks nearly straight and parallel; sides of head set with a few minute spines; postocular spines prominent, blunt, but not knobbed. *Eyes* rounded, not protruding, finely and closely faceted. *Ocelli* widely separated, situated far forward, anterior one on extreme vertex; two small spines in front and one behind each posterior ocellus. *Mouth-cone* slightly longer than its breadth at the base, bluntly pointed. *Antennæ* approximate, about one and one-third times as long as the head, uniformly dark brown, segments 1 and 2 sometimes darker; spines pale and weak; three short sense-cones on segment 3 and two short ones on segment 4.

Prothorax slightly more than three-fourths as long as the head; one long, blunt spine on each posterior angle and one on posterior margin just inside of the former pair; one short spine near the anterior

angles and one on each side near lateral margin nearly equidistant between the spines on the anterior and posterior angles. Sides of *pterothorax* nearly straight, gradually tapering posteriorly, fore angles oblique. *Legs* long and moderately stout, concolorous with the body, except apex of fore tibiæ and fore tarsi, which are light brown. Fore femora greatly enlarged; all femora with a small, stout, anteriorly directed, triangular tooth at the tip within; all femora with a long spine near the base underneath. Fore coxæ with a short spine. Fore tibiæ with a long spine near the tip underneath. Fore tarsi with a small tooth near the middle within and a stout terminal claw. All legs set with numerous short spines. *Wings* extending to distal margin of sixth abdominal segment, narrowed in the middle, brownish at the base; three spines on anterior margin near the base.

Abdomen gradually tapering from the base; concolorous with the rest of the body, purple pigmentation conspicuous in unmascerated specimens; tube one-half as long as head; a few small spines on dorsum and about six weak, long spines at the tip slightly more than one-half length of the tube; a pair of long, slender, pointed spines on the latero-dorsal margin of each abdominal segment. Males similar to females, except smaller, and fore femora more greatly enlarged.

Described from numerous specimens of both sexes taken in July, August, and September, 1910, on a plant determined by Dr. E. L. Greene, of the Bureau of Plant Industry, as *Eriogonum nudum*, at Alum Rock Creek Canyon, San Jose, Cal. (P. R. Jones).

Anthothrips flavipes new species. (Pl. V, figs. 5–7.)

Measurements: Head, length 0.25 mm., width 0.233 mm.; prothorax, length 0.233 mm., width 0.366 mm.; mesothorax, width 0.40 mm.; abdomen, length 1.41 mm., width 0.444 mm.; length of tube 0.15 mm.; total length of body 2.216 mm. Antennæ: Segment 1, 24μ; 2, 48μ; 3, 57μ; 4, 60μ; 5, 48μ; 6, 45μ; 7, 51μ; 8, 30μ; total length of antennæ, 0.36 mm.

General color dark reddish brown.

Head slightly longer than wide, broadest at the base; sides nearly straight, roughened, set with minute spines; postocular spines prominent, knobbed; hind margin of the head not covered with the front margin of the prothorax. *Eyes* finely faceted, rounded, not protruding, not pilose. *Ocelli* large, well separated, posterior ones the largest, anterior one not situated on the extreme vertex; posterior ocelli contiguous with the light margins of the eyes; two small spines just behind each posterior ocellus and two about twice as far in advance of each posterior ocellus. *Mouth-cone* about as long as its width at the base, pointed. *Antennæ* approximate, about one and one-half times as long as the head, separated at the base by a prolonged vertex; color uniform dark brown except segment 3, which is light brown and yellow at the base; segments 2 and 4 slightly tinged with light brown; segment 1 short, cylindrical; segment 2

urn-shaped, with a long base; segment 3 clavate; segment 4 nearly fusiform; segments 5 and 6 more slender and less fusiform; segment 7 narrow, cylindrical; segment 8 sharply conical. Spines pale and weak; sense-cones short.

Prothorax nearly as long as the head; a stout, knobbed spine on each coxa, one on each fore angle, one in each posterior angle, and a pointed spine just inside of the knobbed ones on posterior angles. Fore coxæ large, forming apparently prominent angles. *Pterothorax* nearly as wide as the abdomen; sides nearly straight, narrowed abruptly in front, gradually behind. *Legs* stout, unicolorous with the body, *fore femora greatly enlarged;* fore tibiæ, distal portion of intermediate and posterior tibiæ, and all the tarsi lemon-yellow; a dark spot on all the tarsi near the apex within; *fore tarsi armed with a large stout tooth near the tip within.* *Wings* present, narrowed at the middle, fringes long, single, except hind margin of the fore wing where it is double for 10 to 12 hairs.

Abdomen broadly joined to the metathorax and but slightly wider, less than twice as wide as the head and much more than twice as long as wide; first seven segments equally broad; rest gradually tapering; tube about three-fifths as long as the head. Spines inconspicuous on first five segments, several light colored, long, knobbed, and several pointed spines on postero-lateral margin of segments 6, 7, 8, and 9, more numerous on the latter; tube with a whorl of terminal spines *about twice as long as the tube,* which is only slightly wider at the base than at the apex.

Described from one female specimen collected from an "emergence cage" used for the pear thrips (*Euthrips pyri* Daniel) at San Jose, Cal., 1910 (P. R. Jones).

Near *Anthothrips aculeatus* Fab., but differing in the italicized characters.

34. Genus CRYPTOTHRIPS Uzel.

Key to the Species.

a. Color dark yellowish brown, with no conspicuous purplish pigmentation; head slightly more than twice as long as wide; antennæ concolorous with head, except segment 2, which is yellowish brown, segment 3 brownish yellow, segment 4 light brown; postocular spines prominent, knobbed; ocelli not situated far forward ..... *Cryptothrips salicis* new species.

a'. Color brown to blackish brown, with conspicuous purplish pigmentation; segments 1 and 2 of antennæ concolorous with head, segment 3 and base of 4 yellow, others shading brown toward tip; postocular spines not long and prominent, blunt, not knobbed.... *Cryptothrips californicus* Daniel.

a''. Color uniformly coal-black, except tarsi, which are blackish brown.

b. Antennæ uniformly black; body length about 2.22 mm.; two pairs of prominent postocular spines..... *Cryptothrips carbonarius* Hood.

b'. General color of antennæ black, segment 2 paler at apex, segment 3 with two transverse, brownish-yellow bands, one band at the base and the other in the middle; body length about 2.7 mm.; without prominent postocular spines..... *Cryptothrips rectangularis* Hood.

DESCRIPTION OF NEW SPECIES.

Cryptothrips salicis new species. (Pl. VI, figs. 1–3.)

Measurements: Head, length 0.25 mm., width 0.11 mm.; prothorax, length 0.23 mm., width 0.35 mm. (including coxæ); mesothorax, width 0.33 mm.; abdomen, width 0.41 mm.; total body, length 1.7 mm.; length of tube 0.116 mm. Antennæ: Segment 1, 30μ; 2, 45μ; 3, 59μ; 4, 63μ; 5, 54μ; 6, 45μ; 7, 48μ; 8, 27μ; total length of antennæ, 0.37 mm.

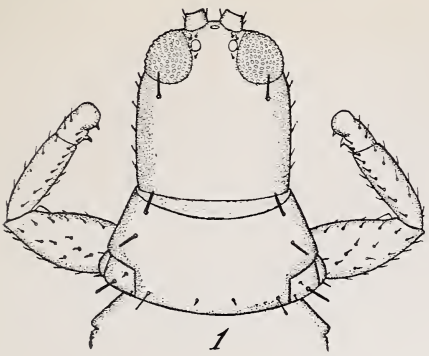
General color dark yellowish brown.

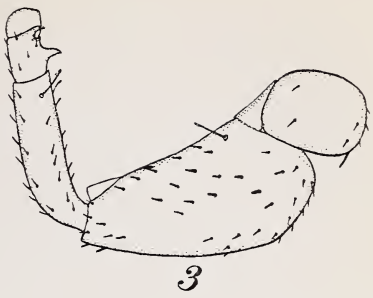
Head cylindrical, about twice as long as wide, somewhat prominent between the basal segments of the antennæ; sides nearly straight, roughened, not pilose, slightly converging posteriorly; head without conspicuous spines except a single prominent knobbed spine posterior to each eye; three small spines in front of and one behind each posterior ocellus. A set of three dark spots just posterior to the ocelli and arranged similarly.

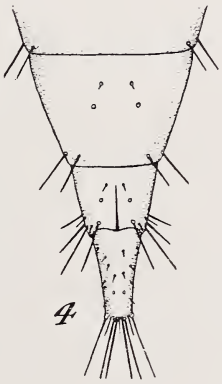
Eyes large, prominent, not protruding, not pilose; facets small, outer ones brownish yellow, remainder of eyes brownish black. *Ocelli* situated far forward; posterior ones contiguous to the inner margins of the eyes, a little proximal to the middle; anterior one not situated on extreme vertex but just distad of a line drawn through the extreme base of the first segments of the antennæ. *Mouth-cone* broad at the base, broadly rounded at the apex, short, extending only to about one-third the length of the prosternum; maxillary palpi quite long and slender. *Antennæ* 8-segmented, separated at the base by a slightly prominent vertex, unicolorous with head, except segment 2, which is yellowish brown, segment 3, which is *brownish yellow*, and segment 4, which is *light brown; segment 3 not noticeably weak.*

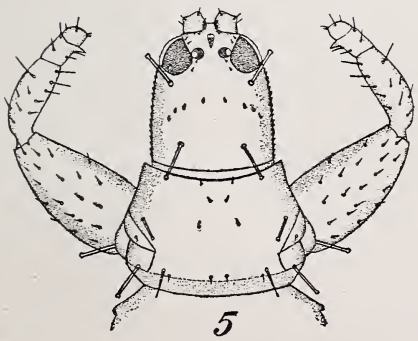
Prothorax large, about one-twelfth shorter than the head; sides straight, extending outward posteriorly; a short, knobbed spine on each anterior angle of prothorax and one long spine on posterior angle of prothorax; also one long spine at the middle of each coxa and one long spine on upper side of each coxa. *Pterothorax* considerably narrower than abdomen; sides almost straight, narrowed abruptly in front, gradually behind. *Legs* dark brown, thickly set with numerous short spines; tibiæ yellowish brown, short and stout; *front femora noticeably thickened;* fore coxæ greatly enlarged. *Wings fully developed,* extending to seventh abdominal segment, slightly narrowed in the middle; both pairs clear and with single fringe except four or five hairs near tip on fore wings, which are double-fringed.

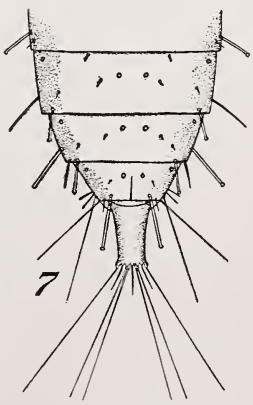
Abdomen long and robust, nearly two and one-half times as long as wide; sides nearly straight to segment 7, which is gradually narrowed; segments 8 and 9 abruptly narrowed; segment 10 (the tube)





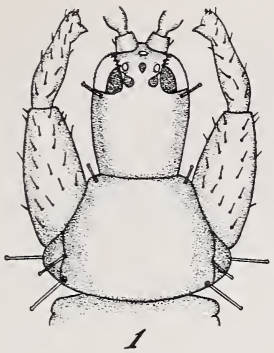


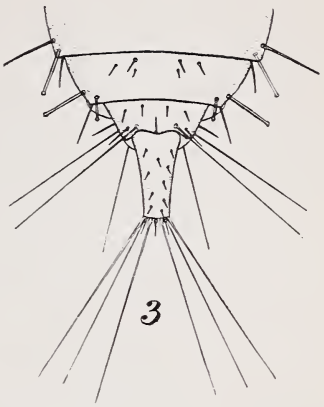


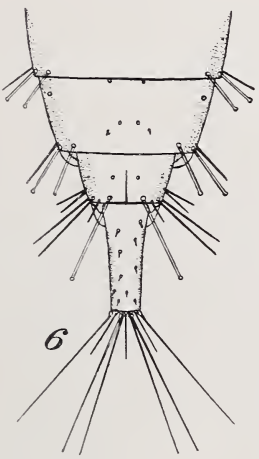


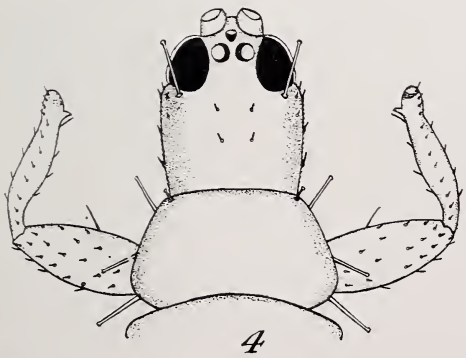
ANTHOTHRIPS.

Fig. 1.—*Anthothrips nigricornis:* Head and prothorax of female. Fig. 2.—*Anthothrips nigricornis:* Right antenna of female. Fig. 3.—*Anthothrips nigricornis:* Left foreleg of male. Fig. 4.—*Anthothrips nigricornis:* End of abdomen of female. Fig. 5.—*Anthothrips flavipes:* Head and prothorax of female. Fig. 6.—*Anthothrips flavipes:* Right antenna of female. Fig. 7.—*Anthothrips flavipes:* End of abdomen of female. Enlarged. (Original.)



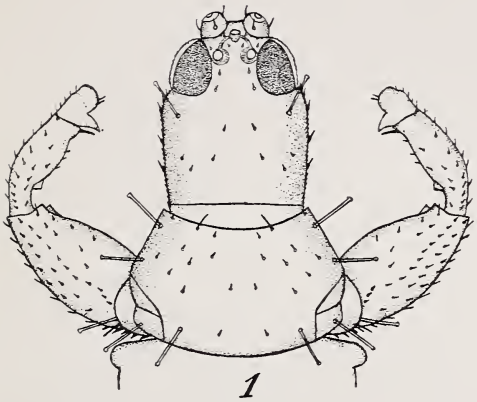


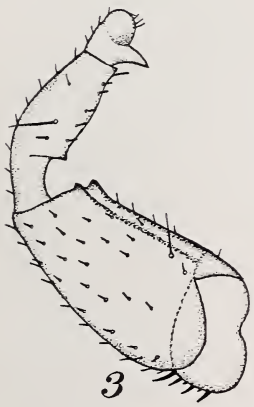


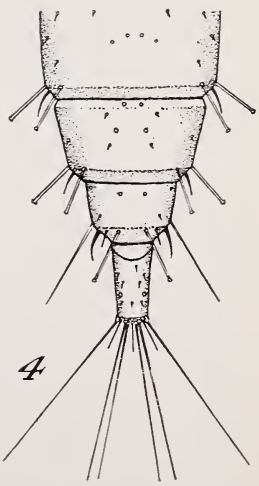


CRYPTOTHRIPS AND PHLŒOTHRIPS.

Fig. 1.—*Cryptothrips salicis:* Head and prothorax of female. Fig. 2.—*Cryptothrips salicis:* Left antenna of female. Fig. 3.—*Cryptothrips salicis:* End of abdomen of female. Fig. 4.—*Phlœothrips jennei:* Head and prothorax of female. Fig 5.—*Phlœothrips jennei:* Right antenna of female. Fig. 6.—*Phlœothrips jennei:* End of abdomen of female. Enlarged. (Original.)

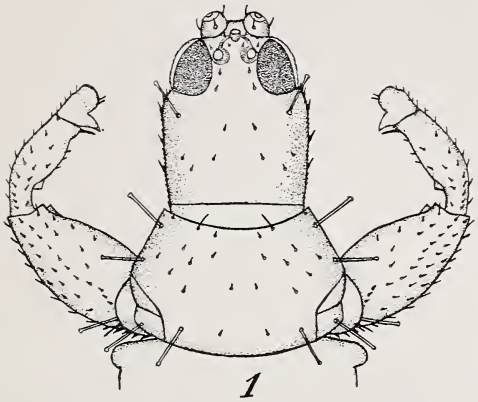


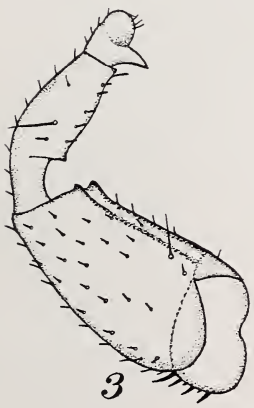


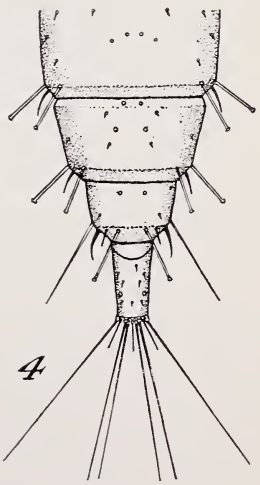


PHLŒOTHRIPS.

Fig. 1.—*Phlœothrips armatus:* Head and prothorax of male. Fig. 2.—*Phlœothrips armatus:* Right antenna of male. Fig. 3.—*Phlœothrips armatus:* Left foreleg of male. Fig. 4.—*Phlœothrips armatus:* End of abdomen of male. Enlarged. (Original.)







PHLŒOTHRIPS.

Fig. 1.—*Phlœothrips armatus:* Head and prothorax of male. Fig. 2.—*Phlœothrips armatus:* Right antenna of male. Fig. 3.—*Phlœothrips armatus:* Left foreleg of male. Fig. 4.—*Phlœothrips armatus:* End of abdomen of male. Enlarged. (Original.)

small and slender, only a little narrower at the apex than at the base. A few nearly inconspicuous spines on posterior lateral margin of each segment, knobbed on first eight segments, with small pointed ones on segments 7 and 8; a whorl of six prominent spines on apex of tube.

Described from one female specimen reared from willow galls, San Jose, Cal., September 15, 1910 (J. R. Horton).

Near *Cryptothrips angustus* Uzel, but differing in the italicized characters.

37. Genus PHLŒOTHRIPS Haliday.

Key to the Species.

1. Postocular spines long and conspicuous.
   - *a*. Segment 3 of antennæ longer than segments 1 and 2 together.
     - *b*. Body color dark reddish brown; head nearly one and one-third times as long as wide; antennæ one and one-third times as long as the head. Segment 3 more than one and one-half times as long as segments 1 and 2 together; male unknown.....*Phlœothrips jennei* new species.
     - *b′*. Body color dark reddish brown; head slightly more than one and one-third times as long as wide; antennæ nearly one and one-half times as long as the head. Segment 3 about one and one-ninth times as long as segments 1 and 2 together; males with teeth at apex of fore femora. *Phlœothrips armiger* new species.
   - *a′*. Segment 3 of antennæ shorter than segments 1 and 2 together.
     - *b*. General color dark brown, tibiæ and tarsi bright yellow; cheeks nearly straight; antennæ one and three-fourths times as long as head; males with teeth at apex of fore femora.....*Phlœothrips uzeli* Hinds.
     - *b′*. General color brown, fore tibiæ and all tarsi light brown; cheeks strongly arched; antennæ one and one-half times as long as head; males with teeth at apex of fore femora.....*Phlœothrips raptor* Crawford.
   - *b″*. General color yellowish brown, with considerable irregular red hypodermal pigmentation, legs grayish brown; cheeks slightly arched; antennæ twice as long as the head; male unknown.....*Phlœothrips pergandei* Hinds.
2. Postocular spines wanting; general color dark mahogany brown, with many small white pigmental markings along head, thorax, abdomen, and legs. *Phlœothrips maculatus* Hood.

DESCRIPTION OF NEW SPECIES.

Phlœothrips jennei new species. (Pl. VI, figs. 4–6.)

Measurements: Head, length 0.31 mm., width 0.25 mm.; prothorax, length 0.18 mm., width 0.36 mm.; mesothorax, width 0.402 mm.; abdomen, width 0.43 mm.; length of tube, 0.2 mm. Antennæ: Segment 1, 22μ; 2, 31μ; 3, 80μ; 4, 80μ; 5, 67μ; 6, 54μ; 7, 52μ; 8, 33μ; total length of antennæ, 0.43 mm. Total length of body, 2.85 mm.

Color dark reddish brown, first seven segments of the abdomen lighter.

Head nearly one and one-third times as long as wide, rounded in front, widest at back of eyes, converging behind; frons protruding

quite prominently between the bases of the antennæ; cheeks arched, roughened, set with four spines on each side arising from quite prominent warts, the posterior pair the stoutest. *Eyes* medium in size, not prominent, with small facets; one pair of long, prominent, knobbed postocular spines. *Ocelli* large, distinct, subapproximate, the anterior one directed far forward; all ocelli reddish yellow, with dark red crescents. *Mouth-cone* long, sharply pointed, reaching to the base of the prosternum. *Antennæ* about one and one-half times as long as head; segment 3 about one and one-half times as long as segments 1 and 2 together; segments 3, 4, and 5 subequal in length, the remaining segments appearing smaller. Segments 1 and 2 dark reddish brown; segment 3 brownish white, darker at apex; segments 4, 5, and 6 darker, but lighter than segments 1 and 2, and lighter at the extremities than in the middle; segments 7 and 8 nearly as dark reddish brown as segments 1 and 2; spines long and conspicuous; sense-cones on segments 3, 4, and 5 stout and long.

Prothorax about twice as long as wide and a little more than one-half as long as the head, with long, dark colored, knobbed spines on the posterior and anterior angles, one pair midlatterally; also a pair on the fore coxæ. *Mesothorax* largest, wider than prothorax; *metathorax* tapering gradually to abdomen, which is abruptly wider. *Wings* slender, extending to middle of fifth abdominal segment, lightly infuscated with brown, with three long, knobbed spines on the anterior margin near the base of the fore pair of wings; both wings with a stripe in the center extending past the middle of the wings, the stripes brown in the posterior pair, transparent white in the anterior pair. *Legs* long and stout; fore femora greatly enlarged, with one long spine on the underside near the base; fore tarsi with a large tooth near the middle. Legs nearly uniform, dark reddish brown, except tarsi, which are light brownish white.

Abdomen large and slender, wider than pterothorax, almost equally wide but tapering slightly to the distal margin of the seventh segment; remaining segments tapering more abruptly; first seven segments lighter than rest of body; spines on segments one to eight knobbed, except one pointed spine on the postero-lateral margin of each segment. Tube slightly more than two-thirds as long as the head, with six long spines on the tip as long as the tube itself, and several short ones; several very small spines on the dorsal surface. Ninth abdominal segment with several long, pointed spines on the latero-dorsal posterior margin and one pair of knobbed spines.

Near *Phlœothrips minor* Uzel in the shape of the antennæ.

One female, collected May 9, 1910, on peach foliage at Barnesville, Ga. (E. L. Jenne.)

Named for Mr. E. L. Jenne, of the Bureau of Entomology, who collected it.

Phlœothrips armiger new species. (Pl. VII, figs. 1–4.)

Measurements: Head, length 0.30 mm., width 0.23 mm.; prothorax, length 0.25 mm., width 0.41 mm.; mesothorax, width 0.41 mm.; abdomen, width 0.41 mm.; length of tube 0.15 mm. Antennæ: Segment 1, 18 μ; 2, 45 μ; 3, 72 μ; 4, 72 μ; 5, 60 μ; 6, 47 μ; 7, 45 μ; 8, 29 μ; total length of antennæ 0.39 mm. Total length of body 2.46 mm.

General color dark reddish brown, not so deep a reddish cast as in the former species.

Head slightly more than one and one-third times as long as wide; sides nearly straight; five warts on each side from each of which there arises a small spine, the posterior one the largest and stoutest; frons projecting considerably between the basal segments of the antennæ. *Eyes* medium in size, not prominent, with small facets; one pair of long, prominent, knobbed postocular spines. *Ocelli* large, distinct, subapproximate, reddish yellow, with dark-red crescents, the anterior one directed far forward. *Mouth-cone* long, sharply pointed, reaching to the base of the prosternum. *Antennæ* slightly more than one and one-half times as long as head; segment 3 about one and one-seventh times as long as segments 1 and 2 together; segments 1 and 2 dark reddish brown, remaining segments uniformly light brown, lighter at the bases and apices, segment 3 lighter than any of the segments; spines long, prominent, numerous; sense-cones not numerous except on segment 2, where the sense area is large and conspicuous and the sense-cones short and thick; several long sense-cones on segments 3, 4, and 5.

Prothorax about one and two-thirds times as wide as long and about five-sixths as long as the head, with long, dark-colored, knobbed spines on the posterior and anterior angles and one pair midlaterally; also one pair on the posterior margin just inside the pair on the posterior angles. Fore coxæ with a long knobbed spine on each coxa and also *armed with four short, very stout, pointed spines.* *Mesothorax* as wide as the prothorax at its anterior angles, abruptly tapering behind them. *Wings* long and slender, transparent, extending to distal margin of the fifth abdominal segment; three long knobbed hairs on the anterior margin of the fore-wings near the base; a very light brown stripe in the center of the posterior pair of wings extending slightly past the middle. *Legs* long and stout, densely spinose; fore femora greatly enlarged, one-half as wide as long. Fore legs evidently raptorial; fore femora with two sharp, toothlike projections at the tip, within, and a groove between them, evidently a sheath for the tibiæ; fore tibiæ with a small, anteriorly-directed tooth near the base within; fore tarsi with an immense tooth on the inner side; fore femora and fore tibiæ each with a long spine underneath, all other spines very

small. Femora and middle and posterior tibiæ concolorous with body; fore tibiæ and all tarsi light brownish yellow.

Abdomen long and slender, tapering gradually from the first segment. First eight segments with knobbed spines; one pair of knobbed spines on the ninth abdominal segment; segments 6, 7, and 8 with several pointed spines in addition to the knobbed spines; segment 9 with several long, pointed, curved spines on the posterior margin. Tube one-half as long as the head, with several small spines on the dorsal surface; 6 long spines, longer than the tube, on the dorsal and latero-dorsal margin; 1 short spine between the two long medio-dorsal spines; no scale at the base of the tube.

One male taken from gall on laurel leaves, Alum Rock Creek Canyon, San Jose, Cal., July 10, 1910 (P. R. Jones).

○

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BUREAU OF ENTOMOLOGY.
L. O. HOWARD, Entomologist and Chief of Bureau.

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AN INTERNAL PARASITE OF THYSANOPTERA.

BY

H. M. RUSSELL,
Entomological Assistant.

ISSUED APRIL 27, 1912.

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MISCELLANEOUS PAPERS.

AN INTERNAL PARASITE OF THYSANOPTERA.

By H. M. Russell,
Entomological Assistant.

INTRODUCTION.

Although many of the injurious forms of thrips have been the subject of exhaustive research, not only in the United States but throughout the entire world, no internal parasites of importance had been reared until 1911. In July the writer reared a parasite from the prepupa of *Heliothrips fasciatus* Pergande, which Mr. J. C. Crawford has described under the name *Thripoctenus russelli*. At the present time the already-published literature on thrips parasites is not so abundant as to preclude a brief review in this paper. In 1860 Mrs. Charlotte Taylor [1] described a parasite of thrips on wheat under the name *Pezomachus thripites*. This insect was figured and described as a small wingless creature, a little larger than its host. The thorax consisted of 2 nodes, while the antennæ were made up of 40 joints and the palpi of 6. These parasites were observed emerging from thrips larvæ in some numbers. They copulated in a short time, after which the female deposited her eggs in the larvæ of the thrips.

Unfortunately this description is so meager that this insect could hardly be recognized unless actually reared from its host again. It represents, therefore, one of our lost species.

In June, 1911, G. del Guercio published a short note on a chalcidid parasite of *Phlœothrips oleæ* (Costa) Targioni. [2] He gave a short description of the appearance of a parasitized thrips and an excellent figure of the same. According to Del Guercio, the parasitic larva seen within the host is of an oval shape, reddish in color, and resembles a dipterous larva. The adult was mentioned only as "an elegant chalcidid," which he stated he would describe, as soon as he had enough specimens. Nothing was written concerning the biology, habits, or relative abundance of this insect.

Del Guercio, in September, 1911, published a further account of this parasite of the olive thrips, to which he gave the name *Tetrasti-*

[1] American Agriculturist, vol. 19, p. 300, 1860.

[2] Redia, vol. 8, pp. 65–68, 1911.

chus gentilii.[1] In this paper he described the adult, of which he stated he had both sexes. According to his observations, these copulate frequently, after which the female seeks out the young larvæ of the host and oviposits in them. The larger larva, prepupa, pupa, and adult stages are passed by in all cases. This insect, he states, passes the winter as larva in its dead host and completes its transformation in the spring. It has been very abundant in Liguria. Del Guercio suggested that by cutting off limbs of the olive infested with parasitized material and shipping the same, this species could be diffused in new localities. It appears from his description of the adult and its habits that he has a larger species than the one referred to in the present paper and with quite different life history and habits.

Dr. L. O. Howard,[2] December 7, 1911, gave a short note on the discovery of the parasite treated in this paper, which is mentioned here as it was the first published note on this insect.

Mr. J. C. Crawford, of the United States National Museum, in December, 1911, described *Thripoctenus russelli* as a new genus and new species.[3] At the same time, the writer gave a brief summary of the life history and habits of this insect.[4]

The present paper, in the light of the information so far obtained on this parasite, aims to present the life history, habits, and economy of *Thripoctenus russelli*. The writer has been ably assisted in the work by Mr. John E. Graf and every point of importance discovered in the life history of this insect has been separately verified by either Mr. Graf or the writer. The writer also wishes to express his appreciation to Dr. L. O. Howard, Dr. F. H. Chittenden, and Mr. J. C. Crawford for their assistance in producing this paper.

HISTORY OF THE DISCOVERY.

The writer, while engaged in the study of truck-crop and sugar-beet insects, at Compton, Cal., began, in May, 1910, an investigation of the life history, habits, and means of control of the bean thrips (*Heliothrips fasciatus* Pergande). From that time until the following fall, frequent collections of the young of this insect were made for study and rearing purposes. On November 10, 1910, the last collection of larvæ of this thrips found that year was made in the yard of the laboratory, for the purpose of determining in what stage this insect passed the winter. These fall-collected larvæ were placed in vials and kept under daily observation and on December 10 four specimens of the prepupal stage of *Heliothrips fasciatus* gave unmis-

[1] Atti Dei Georgofili Di Firenze, 5 ser., vol. 8, pp. 222–227, 1911.
[2] Report of the Entomologist for 1911, U. S. Department of Agriculture.
[3] Proc. Ent. Soc. Wash., vol. 13, p. 233, December 29, 1911.
[4] Ibid., pp. 235–238.

takable signs of parasitism. Two of these died, but on December 13, from the other two, parasitic larvæ had emerged and formed naked pupæ. These parasitic pupæ were sent to Dr. Howard in the hope that the adult could be reared and identified, but unfortunately both died and it was impossible to identify the species. At that time Dr. Howard wrote to the author and advised him of the scientific interest attached to this insect, and requested him to make careful collections of the host larvæ in order to recover the parasite, if possible.

This work was immediately taken up, but it was not until the following year, during February, 1911, that the larvæ of *Heliothrips fasciatus* were again found in the field. From that time until July 1, 1911, large numbers of the larvæ of this thrips were collected and reared to adults, but in no case was there a sign of parasitism. However, on July 3 one prepupa of *Heliothrips fasciatus* gave unmistakable signs of parasitism, but it died before the parasite matured.

While collecting thrips material at Hollywood, Cal., on June 29, 1911, a very minute hymenopteron was observed on the underside of a bean leaf in company with larvæ of this same thrips; and while it was being carefully examined through a small hand lens it appeared to oviposit once in a thrips larva. After this, as the insect was not again observed to come into contact with thrips larvæ, it was captured and put in 50 per cent alcohol. When the minute size of this insect was taken into consideration, it was at once evident that the single case of apparent oviposition must be more or less doubtful, and that it was very essential that the insect be reared to support this observation. This was actually accomplished on July 29, 1911, when an adult of this same species was reared from a larva of *Heliothrips fasciatus*, collected at Hollywood on June 29, 1911. From then until November this parasite has been collected and reared in large numbers.

CLASSIFICATION AND ORIGINAL DESCRIPTION.

Thripoctenus russelli Crawford is a minute insect belonging to the hymenopterous family Chalcididæ and to the subfamily Tetrastichinæ. Mr. Crawford[1] has erected a new genus and species for this insect. He places the genus near *Winnemana*, but separates it from the latter by the absence of two longitudinal grooves on the scutellum.

The following technical description of the genus and species is taken from Mr. Crawford's paper:

Belongs to the tribe Tetrastichini; antennæ with two joints in the funicle, one very small ring joint, club three-jointed, the joints fused; parapsidal furrows indistinct,

[1] Loc. cit.

incomplete; mesonotum without a median groove; scutellum without longitudinal grooves; propodeum without a median carina; spiracles round; submarginal vein very short, marginal vein long, stigmal short, the knob almost subsessile; postmarginal vein developed though not showing distinctly, as it is, as are the other veins, colorless; marginal fringes of anterior wings almost two-thirds as long as the greatest width of the wings.

Female.—Length about 0.6 mm. Head and thorax black, the abdomen brown, with a large basal flavous spot; head thin anterio-posteriorly, collapsing after death; antennæ testaceous, the pedicel longer than the two joints of the funicle combined; second joint of the funicle longer than the first; hairs on antennæ long; head and thorax smooth, polished; legs including the coxæ testaceous; wings hyaline, the veins colorless.

Male unknown.

LIFE-HISTORY SUMMARY OF THE ORIGINAL HOST.

(*Heliothrips fasciatus* Pergande.)

Heliothrips fasciatus Pergande, the original host of this parasite, is found throughout the entire State of California. In the vicinity of Compton, during the months of July and August, the following life-history notes were obtained.

The eggs are laid in the leaves of the food plant and hatch in from 13 to 19 days. The larvæ immediately begin to feed on the leaves of the host plant, generally on the underside, but when crowded appear to thrive on the upper surface of leaves as well. This stage requires from 10 to 12 days, and as soon as the larvæ are full grown, most of them leave the plant to pupate in rubbish or cracks. The prepupal and pupal stages together occupy from 7 to 12 days, making the total length of the life cycle from 30 to 44 days. The insect is thus exposed to the attack of the parasite during the larval stage only, or for from 10 to 12 days.

METHODS OF COLLECTING FOR EVIDENCE OF PARASITISM.

The small size of both the host and the parasite makes it imperative that special methods be adopted in the rearing of these insects. In making collections for evidence of parasitism the bean leaves badly infested by the host thrips were picked and brought into the laboratory in tin boxes. The thrips larvæ were then removed with camels-hair brushes and placed on freshly picked leaves of the food plant. These were then placed in vials (100 mm. in length by 28 mm. in diameter), which had been lined at the bottom with filter paper. (See fig. 1, at left.) It was found that the filter paper absorbed the surplus moisture and the material transformed better than in cases where the filter paper was omitted. These vials were then tightly closed with cotton plugs, labeled, and put into an outdoor insectary. Each day the material was examined, and the larvæ, when necessary, were removed to fresh leaves by means of the brushes. As soon as full

grown the thrips larvæ either pushed in between the vial and edge of the cotton plug or in between the filter paper and the vial, in order to pupate in protected places.

Because of this habit it was very easy to determine parasitism and the amount of material affected. It was found that many of the smaller thrips larvæ died before completing their growth, but this mortality, fortunately, did not retard the investigation.

When it was desirable to discover if material was parasitized or to get adult parasites, the leaves infested with thrips larvæ were put into small wooden boxes with holes bored in the sides for glass tubes.

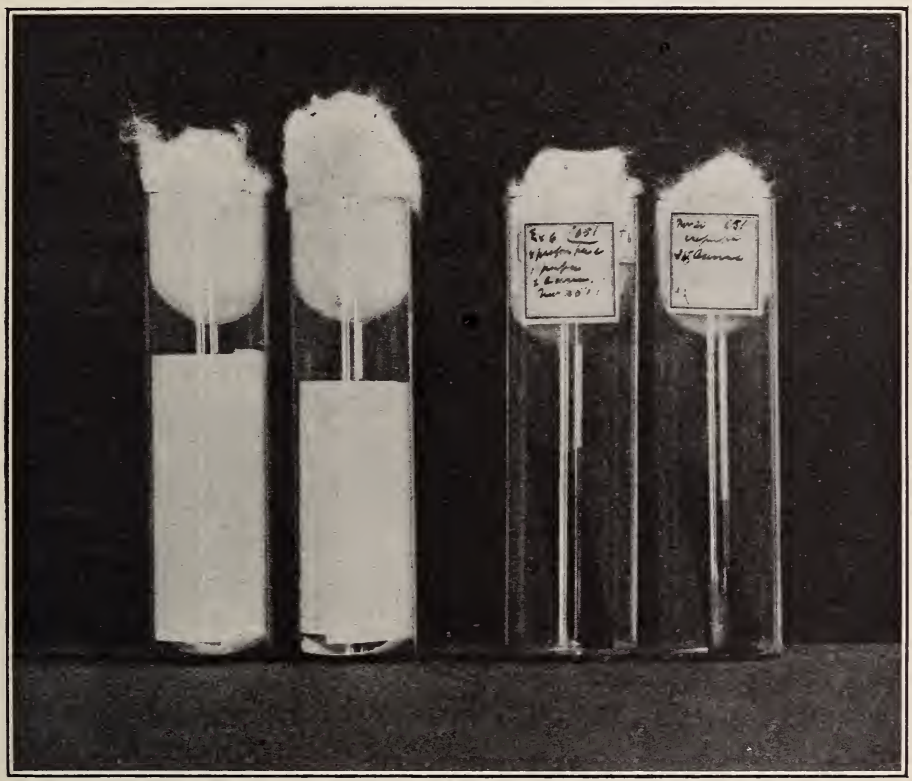

FIG. 1.—Vials used for the study of thrips parasites. (Original.)

(See fig. 2.) These openings were kept closed until the thrips larvæ had all changed, and then the tubes were put in. The parasites upon emerging immediately sought the light and were readily removed from the tubes.

METHODS OF REARING PARASITES FOR LIFE-HISTORY STUDY.

In studying the life history and habits of this parasite, use was made of the large vials described above. In this case, however, the filter paper was left out of the tubes until after the parasite had oviposited in its host. (See fig. 1, at right.) Whenever adults of

this parasite emerged they were placed in these vials with fresh leaves heavily infested with healthy larvæ of this species of thrips. In this way oviposition could be carefully watched, and when desired the parasites were removed to fresh vials. The larvæ in which the parasites had oviposited were carefully changed to fresh leaves whenever necessary until they became mature and pupated.

STAGE OF THRIPS SHOWING PARASITISM.

Although hundreds of parasitized thrips have been observed in the laboratory, in no case has the parasitism ever been evident in any stage but that of the prepupa. The larvæ have been carefully examined at regular intervals but until they have changed to prepupæ it is impossible to ascertain which of the larvæ are actually parasitized. In the prepupal stage parasitism develops rapidly, the growth of the host is retarded, and its death follows shortly. In every instance in which a prepupa has changed to a pupa an adult thrips has emerged from this stage, so that, in so far as our present knowledge is complete, the prepupal stage of the thrips is the only one in which parasitism is evident.

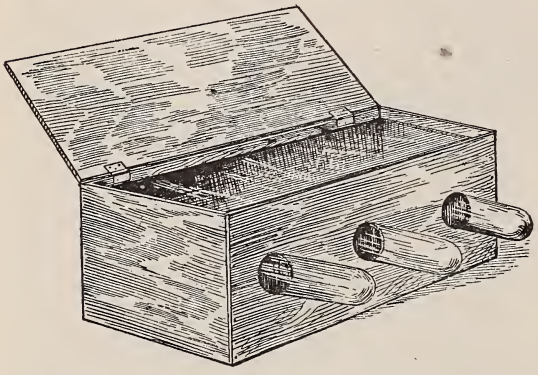

Fig. 2.—Cage for rearing parasites. (From Banks.)

APPEARANCE OF PARASITIZED PREPUPÆ.

Parasitism first becomes evident two or three days after the thrips larvæ have changed to the prepupal stage, and, in case unparasitized prepupæ are in the vial, often after these have further changed to the pupal stage. Parasitism is first indicated in the semitransparent host prepupa when the color contents of the antennæ, head, and anal end of the thrips are removed through the feeding of the internal parasite, leaving the parts hyaline. At the same time there is seen an internal deepening of color in the center of the body. As the feeding of the parasitic larva progresses, the color is more and more directed to the center of the body, and the edges of the body begin to appear hyaline. At about this time the legs of the host larva collapse and sprawl in all directions. A few hours after parasitism is first noticed, the body of the thrips prepupa is swollen and rounded, the original shape being lost. The body is entirely hyaline or colorless except an inner cylinder of deep crimson in *Heliothrips fasciatus* (fig. 3), or yellow in *Thrips tabaci* Lindeman and *Euthrips tritici* Fitch.

BEHAVIOR OF PARASITIZED THRIPS.

The larvæ of thrips that have been parasitized require a few more days for development before changing to the prepupal stage than healthy individuals. It has also been noticed that parasitized larvæ are more apt to change to prepupæ under the paper in the bottom of the vials, while normal larvæ generally crawl up into the edge of the cotton plug before pupating. After parasitism becomes evident in the prepupal stage the doomed insects still have the power of locomotion and will crawl around to some extent. But soon the contents of the limbs are drawn from them and as these collapse all motion in the host thrips ceases.

TIME BETWEEN FIRST INDICATION OF PARASITISM AND FORMATION OF PARASITE PUPÆ UNDER LABORATORY CONDITIONS.

After parasitism becomes evident in the thrips prepupæ, the parasitic larvæ grow very rapidly and within two days, in a few cases, have changed to pupæ of *Thripoctenus russelli;* but the majority change in three and four days. In a few cases this period has taken as long as ten days, but this is unusual and apparently due to some condition unknown at this time. The diagram, figure 4, has been prepared to show the time between the appearance of parasitism and the formation of the parasite pupæ.

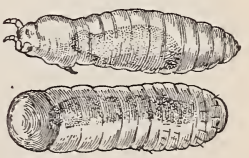

FIG. 3.—Parasitized prepupæ of *Heliothrips fasciatus,* lateral and dorsal views. Greatly enlarged. (Original.)

In a total of 223 specimens, 104, or nearly 50 per cent, changed to pupæ in three days, and 85, or over 38 per cent, in four days.

EFFECT OF COLD ON PARASITIZED PREPUPÆ.

A few experiments were made with parasitized prepupæ of the host thrips to determine the effect of cold on the parasitic larvæ within. On October 19 several parasitized prepupæ were placed in cold storage in a dry atmosphere kept at a constant temperature of 31° F. This material was removed November 27, 1911, and when examined on December 2, by Mr. Graf, all of the parasitic larvæ were found to have emerged and changed to pupæ.

THE PUPA OF THE PARASITE.

FORMATION.

As has been already stated, this parasite invariably completes its growth in the prepupa of its host, and for this reason it changes to the pupal stage in the localities which may have been chosen by its

host for pupation. This, of course, will vary with the different species of thrips attacked. Two years constant work with *Heliothrips fasciatus* has shown that, at least in southern California, the majority of the larvæ of this species pupate in rubbish, in cracks, or under clods of earth. Therefore, when *Heliothrips fasciatus* is the host of this parasite the latter will be found to form its pupæ in the same places. *Thrips tabaci* and *Euthrips tritici* both enter the ground and form oval cells in which to pupate, and thus, when either of these thrips is the host, the pupæ of this parasite will necessarily be formed underground.

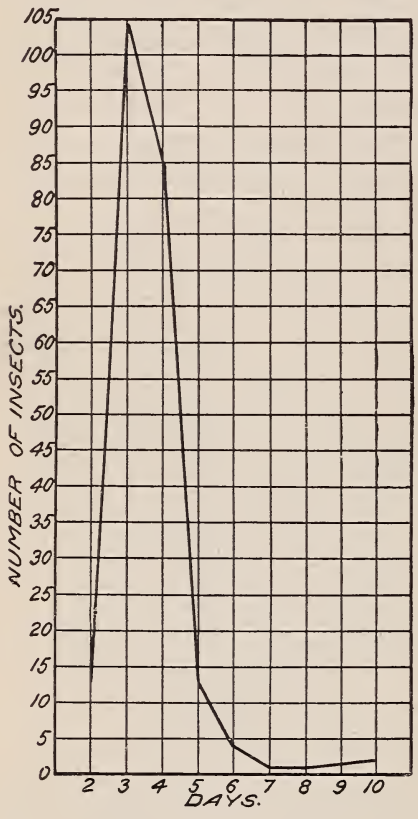

FIG. 4.—Diagram illustrating length of time from appearance of parasitism to formation of parasite pupæ of *Thripoctenus russelli*, July-October, 1911. (Original.)

The parasitic larva, when ready to pupate, splits the skin of the host larva at the anterior end and then gradually works the skin off at the anal end. This molted skin in many cases may be seen lying behind the parasitic pupa.

DESCRIPTION.

When newly formed, the pupa of *Thripoctenus russelli* is almost white, but the intestinal tract in the thorax and anterior part of the abdomen is a bright crimson, similar to the spot in the prepupa of the host that, as stated previously, first indicates parasitism. After a short exposure to the air the edges of the body and appendage cases of the parasitic pupa begin to darken. At first this darker color is of a bluish tint, but it changes more and more to black until the pupa is shining black excepting that portion where the reddish color still shows through. The pupa (fig. 5), which is flattened oval, is rounded in front, but with a slight notch at the center, and is followed by a distinct neck the sides of which are convex. Posterior to this it is abruptly widened to its fullest extent and forms prominent shoulders. The sides then converge very slightly to the beginning of the abdominal segments. The abdomen forms a well-rounded oval, the appendages all being closely appressed to the underside of the pupal shell.

LENGTH OF PUPAL STAGE.

The pupal stage of this hymenopteron requires over one-half of the time of the total life cycle. During the months of July, August, and September, this stage is from 16 to 28 days, but in the majority of cases from 17 to 20 days are required. The diagram, figure 6, has been prepared from the records of 146 individuals, and indicates the length of this stage and the number of individuals for each different length.

EFFECT OF COLD ON PUPAL STAGE.

In order to test the effect of cold, pupæ brought into Washington in September were exposed to outside conditions for over a month. During this time the pupæ remained dormant. About the middle of October these were divided into two lots, one of which was exposed while the other was placed in the greenhouse. After a number of days the adults began to emerge from the pupæ in the greenhouse, in which location the temperature was above the prevailing temperature on the outside, while the lot which had been placed on the outside remained dormant.

FIG. 5. — *Thripoctenus russelli:* Pupa, ventral view. Greatly enlarged. (Original.)

On October 19 Mr. Graf placed a number of pupæ of this species in cold storage at a temperature of 31° F. in both dry and moist atmospheres. On November 28 he removed some of these pupæ and shipped them to the writer in Washington, D. C. On December 4 these were divided into two lots, one of which was placed in the outdoor insectary while the other was placed in the insectary greenhouse. The temperature maintained in this greenhouse is moderately low and so did not tend greatly to hasten development in the pupæ. However, on February 14 and 17, adults emerged 79 and 82 days after the pupæ were removed from cold storage, in which they had been kept for 41 days. During the three weeks previous to emergence of the adults the average mean temperature in the greenhouse was 65.5° F. February 20 the pupæ in the outdoor insectary were still unchanged.

THE ADULT PARASITE.

EMERGENCE.

The emergence of the adult parasite is best described by Mr. Graf's notes as taken at the time of observation, August 9, 1911.

Several adult parasites were emerging from the pupal cases and were carefully watched. In every case noted, the anterior end of the pupal case, covering the face

of the contained parasite, split off and the parasite began to emerge. In addition to the anterior opening, the pupal case, in mary instances, split down the back, although this did not hold true with all. In one case the split-off anterior end of the pupal case adhered to the face and antennæ of the newly emerged insect and it required fully an hour from the time the parasite was entirely freed from the pupal case until it was freed from that portion which covered its face.

The longest time in the period of emergence was consumed by the insect in freeing its head and thorax from the pupal case. After this was accomplished the insect rapidly worked the case from its abdomen by the aid of its posterior legs.

The time of emergence noted varied greatly, depending probably upon the strength of the individual and the hardness of the pupal case. The shortest time noted was 4½ minutes from the time the pupal case first began to split until the adult parasite was entirely free. The longest period noted was 1⅓ hours. These both seemed to be exceptional cases, as five others were timed as follows: (1) 21 minutes, (2) 33 minutes, (3) 25 minutes, (4) 28 minutes, and (5) 36 minutes.

For a short time after freeing itself from the pupal case, the adult parasite remains in one position, busily engaged in cleansing its body. The head and antennæ are cleansed by the fore legs and the wings and body by the hind legs. These are then cleansed by drawing them through the mandibles.

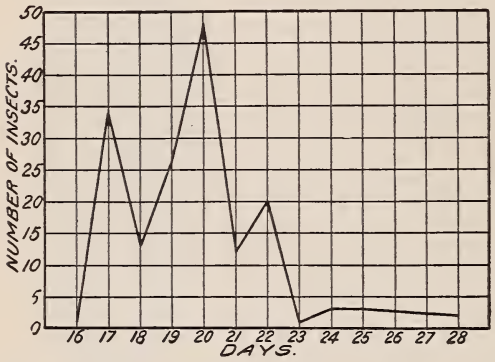

FIG. 6.—Diagram illustrating length of pupal stage in 146 individuals of *Thripoctenus russelli*. (Original.)

When the adult first emerges there is a suggestion of pink color in the abdomen. This is explained by the fact that this parasite in the larval stage does not expel any excrement, and this accumulation of waste matter is of necessity still contained in the abdomen and imparts to it the crimson color so noticeable in parasitized prepupæ. During the change from larva to pupa this waste product still remains and is, in fact, as before stated, in the abdomen of the adult upon emergence. In a short time, however, the adult expels this semiliquid, and it forms several minute red spots on the surface beneath.

DESCRIPTION OF NEWLY EMERGED, LIVE ADULT.

The living adult of *Thripoctenus russelli* is a very minute insect, being about 0.7 mm. long and 0.2 mm. wide. The head is black, with dark red eyes and light yellow antennæ. The thorax is bluish black with the wings hyaline and the legs light yellow, while the abdomen is light yellow with more or less black toward the anal end. The ovipositor is nearly concealed when not in use, but when extended is very long, slender, and light yellow. This insect is shown in figure 7, so that with the technical description on page 35 a more lengthy description at this time is unnecessary.

RELATION AND PROPORTION OF SEXES.

During the course of this investigation hundreds of specimens of this insect have been reared, but among this number it has been impossible to find a single male. Furthermore, up to October 1, 1911, a generation of females had been reared from a female and these in turn had oviposited in their host. Regarding the length of time this insect might continue to multiply without the introduction of the male, or what proportion of males might be produced, it is impossible to determine at the present writing.

PARTHENOGENESIS.

This insect reproduces parthenogenetically to a large extent, for, as the accompanying table indicates, in every one of a number of

FIG. 7.—*Thripoctenus russelli:* Adult. Greatly enlarged. (Original.)

experiments performed to determine this point, the fact was clearly proven by the development of the parasite in thrips larvæ oviposited in by unfertilized females.

TABLE I.—*Results of oviposition by unfertilized females of Thripoctenus russelli.*

Experiment No.	Date of oviposition by unfertilized female.	First sign of parasitism.	Number of host parasitized.	First adult parasite emerged.	Last parasite emerged.	Number of parasites emerged.
1	Aug. 13	Aug. 20	56	Sept. 11	Sept. 20	44
2	...do	Aug. 21	35	Sept. 12	Sept. 18	25
3	Aug. 14	Aug. 20	10	Sept. 11	Sept. 13	7
4	Aug. 15	Aug. 21	6	Sept. 12	Sept. 15	5
5	Aug. 19	Aug. 26	7	Sept. 18	Sept. 28	5
6	Aug. 20	Aug. 27	31	Sept. 19	Oct. 2	18

These six experiments with six unfertilized females gave a total of 135 parasitized forms, and from these were reared 104 parasite adults.

In many other species of parasitic insects where adults have been reared from eggs deposited by unfertilized females, the offspring have all been males.[1] However, in so far as we have progressed in the rearing of this parasite artificially, the offspring of unfertilized females have been females, for in every case these insects, when placed separately in vials with thrips larvæ, began to oviposit in their host. In one case at least the prepupa of the thrips developed signs of parasitism from the unfertilized egg of the second generation.

Table II shows results of 9 experiments to show effect of parthenogenesis in offspring of the first generation.

TABLE II.—*Effect of parthenogenesis on offspring of first generation of Thripoctenus russelli.*

Exp. No.	Date.	Experiment.	Action.	Result.
1	Sept. 13	Unfertilized parasite, reared from egg deposited by unfertilized female, placed in vial with thrips larvæ.	Insect proved itself to be female by ovipositing immediately.	Sept. 24, 1 parasitized prepupa appeared.
2	...do.....	.....do.....	.....do	No result.
3	...do.....	.....do.....	.....do.....	Do.
4	...do.....	.....do.....	.....do.....	Do.
5	Sept. 14	.....do.....	.....do.....	Do.
6	Sept. 15	.....do.....	.....do.....	Do.
7	Sept. 16	.....do.....	.....do.....	Do.
8	Sept. 18	.....do.....	.....do.....	Do.
9	Sept. 23	.....do.....	.....do.....	Do.

METHOD AND PERIOD OF OVIPOSITION.

Oviposition was observed under laboratory conditions in many cases, and in nearly all the operation was identical. The females of this insect, within a few hours after emerging from the pupa, and in all cases under observation, without being fertilized by the males, when placed on a leaf with thrips larvæ began to oviposit as soon as they had located their hosts. The time required for this, of course, varied, as some species of thrips were not as active as others, nor as easily disturbed, so that the parasite had little trouble in finding them. The process is probably best described by the author's notes on oviposition in *Heliothrips fasciatus* taken at the time of observation.

The female, in ovipositing, crawled very slowly over the leaf with her antennæ diverging but horizontal and constantly moving from side to side. In this manner she moved over the leaf more or less in a circle until she came in contact with the larva of *Heliothrips fasciatus*. At this point the antennæ were drawn closely together and moved carefully and slowly over the larva from one end to the other; then, if she

[1] See pp. 257–258, Bul. 91, Bur. Ent., U. S. Dept. Agr. The Importation into the United States of the Parasites of the Gipsy Moth and the Brown-tail Moth. By L. O. Howard and W. F. Fiske.

appeared satisfied, the antennæ were dropped downward, touching the larva. The abdomen was curved under the body and a long, slender, yellowish ovipositor extended from near the anal end of the body. This was quickly thrust into the body of the thrips larva, and as soon as the egg was deposited the ovipositor was withdrawn. Generally this was easily done, but in a few cases a short struggle was necessary before it could be accomplished. The ovipositor was usually inserted into the abdomen near the anal end, but sometimes it is thrust into the side of the thorax. In one instance, where the larva had been approached from in front, the ovipositor was inserted into the front of the body. After the egg was deposited the parasite in some instances would immediately select a new victim or she would rest while cleansing her legs, antennæ, and body and then resume her quest. In other cases, after carefully examining a host larva she would leave it without attempting to oviposit. On some occasions the female was observed to deposit an egg in a larva and after leaving it would shortly return to the same one and oviposit a second or even a third time. In the majority of cases the larvæ of *Heliothrips fasciatus* did not seem to be in the least disturbed by this action. While the writer was engaged in observing oviposition he timed the parasite from its first touching of the host larvæ with its antennæ until the ovipositor was finally withdrawn and in three cases this procedure occupied 20, 50, and 30 seconds each. One female was carefully watched and in 5 minutes oviposited in 4 different larvæ and rejected two others after short examination. During the second 5 minutes this female deposited 2 more eggs. Another female, recently emerged, was placed in a vial with a large number of larvæ of this thrips at 3.15 p. m. At 3.25 p. m. she had deposited her first egg and during the next hour, under the constant observation of the writer, she deposited 20 eggs in 18 larvæ in a period of 35 minutes, and 38 eggs in 36 larvæ in 60 minutes.

Oviposition in the larvæ of *Thrips tabaci* was identical with that in *H. fasciatus,* but the thrips larvæ were more active and more easily alarmed so that they either moved away or violently threw the tip of the abdomen around. In such cases, the parasite retreated but in a short time again approached the larva and in most cases after two or three failures would eventually succeed in ovipositing in the larvæ. The same thing was noticed with the larvæ of *Euthrips tritici,* but in both cases the parasite by returning to the attack generally accomplished her purpose. The same parasite was often placed with one after another of these three species of thrips and would oviposit in each one without appearing to notice the difference. In one case a parasite was observed trying to oviposit in a dead thrips larva that was still more or less soft. Still another adult was observed attempting oviposition in a soft lump of dirt in the vial.

This parasite does not seem to prefer any particular size of larva, as it has been seen to oviposit in all sizes, from larvæ not over a day or two old to larvæ ready to change to prepupæ. If, while examining the leaf for thrips larvæ, it encounters a larva from in front, the parasite generally moves around to the side and then oviposits in the region of the thorax or the abdomen.

HABITS IN THE OPEN.

Oviposition as observed in the field is not very different from that in the laboratory. The following notes were taken while watching the parasite on foliage of turnip infested with *Thrips tabaci:*

The female was observed crawling slowly along with the antennæ in motion and turned first to one side and then to the other; the body also was turned to one side or the other. At other times she ran very rapidly across the leaf. Finally she discovered a larva of *tabaci* and immediately placed her anterior legs on it and lowered her antennæ until they rested on the body. She then oviposited in the host in the same manner that was observed so many times in the laboratory. In nature, however, the thrips larvæ were more scattered, so that this insect succeeding in finding and ovipositing in only 4 larvæ during 40 minutes, and to do this she covered nearly 6 square inches of leaf surface.

In other cases where this insect was observed in the open, a slight jar would frighten her and instantly she would take wing.

EFFECT OF OVIPOSITION IN DIFFERENT STAGES OF HOST.

In the course of the work in rearing the thrips parasite it was found that this insect would oviposit in all stages of the host. In order to determine if the parasite would develop in all stages, a number of experiments were performed in which the parasite was placed in a vial with prepupæ and pupæ of *Heliothrips fasciatus;* and in every case the parasite did not hesitate to oviposit freely in these stages. In spite of this not a single form ever developed the slightest sign of parasitism, and the host adult developed in all cases. From these experiments, it appears, we can safely say that, although this insect will oviposit in all forms of this thrips, it will develop successfully only when the eggs are deposited in the larval stage of the host.

NUMBER OF EGGS AND LENGTH OF OVIPOSITION PERIOD.

Because of the extremely artificial conditions that were necessary in rearing this very minute hymenopteron, it is impossible even to estimate with any degree of correctness the egg-laying capacity of a female under normal conditions. This is due not only to the fact that the parasite is apt to die before the normal number of eggs is deposited, but also largely to the artificial method of rearing, by reason of which many of the host larvæ that have been parasitized die before they show the usual indications of parasitism. In one case a female was observed, under laboratory conditions, to oviposit in 36 larvæ of *Heliothrips fasciatus* 38 times in 1 hour. From the oviposition record of another female, 56 parasitized prepupæ developed, while a third, that undoubtedly parasitized a still larger number, gave a total of 91 parasitized forms that later developed.

The parasites in the vials were observed to oviposit in thrips, as a rule, during a period of 5 days, although in one instance a female

was noted that oviposited on the first and eighth day while confined in a vial with larvæ of *Thrips tabaci*, at Washington, D. C. This oviposition period undoubtedly is shorter than that which occurs under conditions which are normal, for, confined in the vials, the parasites were in close contact with many thrips larvæ, their eventual hosts, and so might deposit their eggs faster, while in the open field the parasites were compelled to spend considerable time in searching among the leaves for the thrips larvæ. Undoubtedly this alone would lengthen the normal period of oviposition to at least double that over which oviposition was observed to occur under artificial conditions in the laboratory.

DOUBLE PARASITISM.

Although it has been frequently observed that this parasite would oviposit in the same host two or even three times, only one adult hymenopteron has ever been reared from these doubly-parasitized specimens, and in nearly every case only one parasitic larva has seemed to develop in them. On one occasion, however, Mr. Graf, late in November, 1911, observed a case in which double parasitism had developed and under such conditions that its success was plainly indicated. At that time he took the following notes:

In the prepupa that was doubly parasitized, the parasitic larva occupying the abdomen of the thrips was about full-sized and no great difference in size could be noted in the alimentary canal of this one as compared with the others. The second parasitic larva occupied the thorax of the host prepupa, with one end of its body against one anterior angle of the thorax of the host, while the other end was against the opposite posterior angle. The colored portion was about one-fourth natural size, and it was more of a yellowish red. It was well shaped however, and not in the least distorted by its position. Under the high-power lens there was a plain division between the two and there was no mistaking the fact that there were two distinct hymenopterous larvæ occupying the body of the prepupal host at the same time. Judging from the appearance under the lens, the larva occupying the abdomen of the host would have been able to develop and pupate, while the one located in the thorax, due to its cramped position and inadequate food supply, would have been unable to reach the pupating stage and would have died.

Unfortunately this host was killed so that no data were obtained as to whether either of the parasitic larvæ would have been able to complete its transformation. However, double parasitism must always result in the death of one of the larvæ and in such a small host undoubtedly in many cases both must die owing to the insufficient nourishment afforded by such a minute host.

ACTIVITY.

While the adult parasite is usually quiet, during the period just after emerging from the pupal case it is, under normal conditions, like most of the Hymenoptera, a very active insect. At times it has

been noted to travel over the leaf surface with astonishing speed for so minute a creature, but in the majority of cases which came under observation it seemed to crawl over the leaf in a slow and cautious manner, turning first to one side of the leaf and then to the other, apparently in constant search of its host. Unless disturbed it was seldom noted to take flight, but if jarred or frightened it takes wing at once.

FLIGHT.

This insect is quite capable of sustained flight, as shown by the fact that Mr. Graf captured an adult in the outdoor insectary, on a shelf 5 feet above the ground and about 15 feet from the foliage which held the parasitized thrips. On September 27, 1911, Mr. Graf incorporated in his notes the following:

> On this date two adult parasites were noted in flight. In both instances the parasites flew from the desk to the window, a distance of about 24 inches, and probably could have flown a much greater distance. The characteristic rapidity of their short flights in the vials was lacking and they flew slowly and in a zigzag line. Their flight resembled very much that of a fly in its aimless circuit about a room. During the flight they maintained about the same level, so it is probable that these insects are relatively strong fliers. It is probable that in still air or traveling with an air current they could traverse quite a distance and thus be scattered quite rapidly. This fact is further borne out by the rapidity with which parasitized material of *Thrips tabaci* was taken from all points of a patch of turnips once it had started to show in one place.

SIGHT.

Although this parasite has large eyes, it does not appear to distinguish objects very plainly or at any great distance. In many cases it was observed, while searching for larvæ of its host, to pass near them; so close, in fact, as almost to touch them. In one instance a female, while traveling across a leaf very rapidly, was observed to run halfway over a thrips larva, and then, as if just aware of the presence of its host, to stop, back off, and immediately oviposit in it. It is attracted to light and will travel toward it in the vials so that by turning the bottom toward the window, the cotton plugs may be removed without danger of losing the insect.

BEHAVIOR ON DIFFERENT KINDS OF LEAF SURFACES.

In the course of the laboratory experiments with the thrips parasite it was observed that it experienced considerable difficulty in moving over the surface of a leaf if the latter was hairy or sticky. On leaves with smooth, glaucous surfaces, such as cabbage, turnip, or wild lettuce, this insect moved with rapidity and without apparent difficulty. But on the underside of leaves such as nasturtium and Chinese gourd, the movements were delayed and often ceased while the insect cleaned its legs. Because of this condition oviposi-

tion was very slow on leaves of the latter type and the percentages of thrips larvæ parasitized in such experiments were low. Without doubt this same difficulty arises in nature, so that thrips living on plants with spiny or sticky leafage will not be so highly parasitized as those living on plants with smooth leafage.

HOST RELATIONS.

Heliothrips fasciatus Pergande.

The parasite in question, *Thripoctenus russelli* Crawford, was first discovered in the larvæ of *Heliothrips fasciatus* Pergande, and when the adult parasites were first reared they were naturally confined in vials, with the young of this species, and at once oviposited in them. These were carefully manipulated and the parasites later reared in large numbers under laboratory conditions. Collections of this thrips made at various times during 1911 have shown it to be regularly parasitized by this hymenopteron.

Thrips tabaci Lindeman.

As soon as oviposition was noted in larvæ of *Heliothrips fasciatus*, larvæ of the onion thrips (*Thrips tabaci* Lindeman) were substituted for those of *Heliothrips* as a possible host for the parasite, with the result that oviposition took place at once. From these onion thrips larvæ the parasites were successfully reared in large numbers. On September 2, 1911, this parasite was observed actively ovipositing in larvæ of *Thrips tabaci* in the field and from collections of larvæ of this species made at that time the parasite was reared in large numbers. (See Table III.)

TABLE III.—*Parasitism of Thrips tabaci as shown by field collections at Compton, Cal., 1911.*

Lot No.	Date.	Number parasitized.	Lot No.	Date.	Number parasitized.	Lot No.	Date.	Number parasitized.
1	Aug. 30	52	9	Sept. 15	96	17	Sept. 23	23
2	Sept. 2	16	10	Sept. 16	30	18	Sept. 25	14
3	Sept. 5	24	11	Sept. 18	46			
4	Sept. 9	29	12	Sept. 19	40	Total number of parasitized forms		602
5	Sept. 11	45	13	Sept. 20	50			
6	Sept. 12	20	14	Sept. 21	15			
7	Sept. 13	34	15	Sept. 22	23			
8	Sept. 14	28	16	Sept. 23	17			

The percentage of parasitism of this species in September, 1911, ranged in different collections from 15 per cent to 60 per cent, while the average of 7 lots was 33.5 per cent, as shown in Table IV.

TABLE IV.—*Percentage of parasitism of Thrips tabaci by Thripoctenus russelli at Compton, Cal., 1911.*

Lot No.	Date of collection.	Number parasitized.	Per cent of parasitism.
1	Aug. 30	52	35
2	Sept. 2	16	15
3	Sept. 5	24	40
4	Sept. 11	45	30
5	Sept. 13	34	30
6	Sept. 14	28	25
7	Sept. 15	96	60
Total		295	
Average			33.5

In October, from the pupæ of this parasite sent to Washington, D. C., from Compton, Cal., adults were reared which, when placed in vials with larvæ of *Thrips tabaci*, immediately began to oviposit in them. Unfortunately the parasitized larvæ soon died, the parasites perishing with them, and but few data were secured from this experiment. It is possible that this mortality of the host was due to the cool weather which prevailed at the time of the experiment.

These experiments demonstrate the important fact that the parasite *Thripoctenus* will oviposit in the larvæ of *Thrips tabaci*. This later may be an important asset in the control of this destructive insect.

Euthrips tritici Fitch.

Adults of *Thripoctenus*, when confined with larvæ of *Euthrips tritici* Fitch, immediately commenced oviposition. As a result, although the larvæ of this thrips are more difficult to rear, the parasite was successfully reared in a number of experiments. No evidence of parasitism in the open was observed for this species, but as the larvæ were at no time very abundant, sufficient data were not secured to determine whether this insect was being parasitized in the field.

Heliothrips hæmorrhoidalis Bouché.

A series of experiments was conducted in which the larva of *Heliothrips hæmorrhoidalis* Bouché was confined with this parasite and in every case oviposition was noted many times. However, with the exception of one doubtful example, no indication of parasitism ever appeared. To account for this failure is impossible at the present time unless it was that the host larvæ were in a far too advanced state.

Heliothrips femoralis Reuter.

Adults of *Thripoctenus russelli* that emerged in Washington on October 2, 1911, were confined with the larvæ of *Heliothrips femoralis* Reuter and they immediately commenced oviposition. These

experiments also failed to give any further results, due no doubt to the fluctuating temperature of the building where the experiments were conducted.

MISCELLANEOUS OBSERVATIONS.

Larvæ of *Trichothrips* n. sp. were confined with the parasite, but whenever the parasite came into contact with the larvæ it at once moved away and upon no occasion did it attempt oviposition. The refusal of the parasite to oviposit was no doubt due to the fact that this thrips was much larger, of an advanced stage, and with a tougher skin.

While observing the oviposition of the parasite in thrips larvæ, one was observed to come into contact with a small red spider (*Tetranychus ?*). The parasite immediately stopped, examined the mite, and then bent under the abdomen and oviposited in it. Undoubtedly this was a case of wasted energy, as the body of the mite was entirely too small to nourish the larva of the parasite.

Young of *Triphleps insidiosus* Say were placed in a vial with the parasite, but no attempt to oviposit was observed. In most cases the young bugs moved so rapidly that the parasite could not get near enough to touch them.

In one experiment Mr. Graf placed very young cabbage aphides (*Aphis brassicæ* L.) in the vial with the thrips parasite, but it refused to oviposit in them.

SUMMARY OF EXPERIMENTS TO DETERMINE HOST RELATIONS.

To briefly summarize the results of the foregoing experiments, this parasite has been reared from *Heliothrips fasciatus* Pergande, *Thrips tabaci* Lindeman, and *Euthrips tritici* Fitch. It has also been observed to oviposit in larvæ of *Heliothrips hæmorrhoidalis* Bouché and *Heliothrips femoralis* Reuter, but without results at the present writing. Upon one occasion, as noted above, it oviposited in a red spider, also without results. Although given the opportunity it refused even to attempt oviposition in *Trichothrips* n. sp., *Triphleps insidiosus*, or *Aphis brassicæ*.

LENGTH OF LIFE IN CONFINEMENT.

Owing to the artificial conditions under which this insect was studied, the normal length of life must have been greatly curtailed. However, adults were often noted in active oviposition for from 3 to 5 days and one was recorded that oviposited on the first and eighth days of its confinement. Adults have been kept alive in the tubes for a period of 10 days. In another case adults were found alive in a shipment of material that was in the mail for 2 days. This insect probably has quite an extended length of life under natural

conditions, but its minute size renders it almost impossible to determine this point.

Samuel Doten [1] has recently published some interesting information on the relation of food to the length of life of certain parasites kept in confinement. He found that under favorable conditions some species could be kept alive in confinement for months.

CAUSES OF MORTALITY IN THE OPEN.

Many of the adults of this tiny hymenopteron suffer an untimely death, instances of which have been observed in the present investigation. It was a common sight to see two or three entangled in a spider's web on the underside of a single leaf, and these invariably perished, as they were too frail to extricate themselves. On one occasion the larva of a syrphid was observed to seize one of these parasites and kill it. The larva of *Triphleps insidiosus* was also noted, in one instance, with this insect impaled on its beak.

One female of *Thripoctenus russelli* was observed on a croton leaf, attempting oviposition in the larva of *Heliothrips hæmorrhoidalis*. It was frequently caught by the sticky excrement of its host, and only with great difficulty succeeded in freeing itself. On the next morning this parasite was found fastened to the leaf and dead. Thus the excrement of the larvæ of *Heliothrips* may serve as a protection to the thrips against its natural enemy.

EFFECT OF OVIPOSITION IN DIFFERENT AGES OF HOST LARVÆ.

At the present time our observations show that the degree of maturity of the host larvæ bears some relation to the length of time between oviposition by the parasite and indication of parasitism in the host. In all cases observed where the parasite oviposited in larvæ that were nearly fully grown either the parasitic larvæ did not develop or the length of time required for their development was lengthened a number of days. Also in one experiment where oviposition took place in thrips larvæ only 2 days old the length of time required until there were signs of parasitism was 14 days—considerably more than the average. It appears that the best results are obtained when the parasite selects host larvæ about half grown as its victims.

LIFE HISTORY.

The life history of *Thripoctenus russelli* is taken from records made under artificial conditions, as the material was confined in vials closed by cotton plugs. These were kept in an open-air insectary; hence the other conditions were as nearly natural as it was possible to make them. The fluctuations of temperature were recorded on a

[1] Tech. Bul. 78, Nevada Agr. Exp. Sta., September, 1911.

Freize thermograph. The observations covering the life-history studies of the parasite were made during the months of July, August, and September.

LENGTH OF TIME FROM OVIPOSITION TO FIRST INDICATION OF PARASITISM.

Because of the very minute size of this insect and the internal life led by it in the larval stage, the length of the egg and larval stages was not separately determined. The time required from oviposition by the adult parasite until parasitism becomes evident in the host may be 5 days as a minimum or 17 days as a maximum, but by far the greater number require from 7 to 12 days for this. In Table V this period is recorded for a series of 19 experiments.

TABLE V.—*Time between oviposition and first indication of parasitism, by Thripoctenus russelli.*

Experiment No.	Parasite oviposited in host larvæ.	Number parasitized larvæ observed.																				Total parasitized.
		August.																September.				
		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	
1	Aug. 9	...	...	...	4	8	4	0	4	...	...	...	...	...	...	...	...	...	...	...	...	20
2	...do	...	...	...	1	1	2	1	1	0	1	...	...	...	...	...	...	...	...	...	...	7
3	Aug. 11	2	1	0	5	0	3	0	0	2	3	5	...	...	...	...	...	...	...	...	...	21
4	Aug. 12	...	...	...	1	2	2	0	3	1	...	...	...	...	...	...	...	...	...	...	...	9
5	...do	...	...	...	1	3	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	7
6	...do	...	...	...	1	0	0	0	...	...	...	...	...	...	...	...	...	...	...	...	...	1
7	Aug. 13	...	...	...	...	3	3	8	16	10	13	3	...	...	...	...	...	...	...	...	...	56
8	...do	...	...	...	...	...	2	1	14	7	7	4	...	...	...	...	...	...	...	...	...	35
9	Aug. 14	...	...	...	...	4	3	2	1	...	...	...	...	...	...	...	...	...	...	...	...	10
10	...do	...	...	...	...	4	0	1	1	0	1	...	...	...	...	...	...	...	...	...	...	7
11	...do	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	2
12	...do	...	...	...	...	...	2	2	1	1	2	2	...	...	...	...	...	...	...	...	...	10
13	Aug. 15	...	...	...	...	...	2	5	1	...	...	...	...	...	...	...	...	...	...	...	...	8
14	...do	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	2
15	...do	...	...	...	...	...	10	14	13	6	4	4	0	6	1	0	0	1	9	...	...	68
16	...do	...	...	...	...	...	5	0	0	0	0	1	...	...	...	...	...	...	...	...	...	6
17	Aug. 19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	8	10	8	3	1	39
18	...do	...	...	...	...	...	...	...	...	...	...	5	2	0	0	...	...	...	...	...	...	7
19	Aug. 20	...	...	...	...	...	...	...	...	...	...	...	1	2	2	3	9	3	6	4	...	30
Total	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	345

The diagram, figure 8, gives the length of time between oviposition and indication of parasitism for 353 specimens.

LENGTH OF TIME FROM OVIPOSITION TO PUPATION OF THE PARASITE.

The length of time from oviposition to pupation of the parasite, or the period covered by the egg and larval stages, was carefully determined for 241 specimens and varied from 8 days, as a minimum, to 19 days as a maximum; but 13 or 14 days are required by the greater number of individuals. Figure 9 shows this period.

As the length of the pupal stage was taken up in the discussion of the pupa (p. 33) it is not again referred to here.

LENGTH OF LIFE CYCLE.

The life cycle is shown in Tables VI, VII, and VIII, including the average mean temperature for the period.

TABLE VI.—*Length of life cycle of 44 individuals of Thripoctenus russelli.*

Date of oviposition.	Sign of parasitism.		Parasite larvæ pupated.		Adult emerged.	
	Date.	No.	Date.	No.	Date.	No.
Aug. 13	Aug. 20	3	Aug. 22	1	Sept. 11	1
	Aug. 21	3	Aug. 23	2	Sept. 12	4
	Aug. 22	8	Aug. 24	3	Sept. 13	8
	Aug. 23	16	Aug. 25	7	Sept. 14	7
	Aug. 24	....	Aug. 26	9	Sept. 15	10
	Aug. 25	10	Aug. 27	3	Sept. 16	4
	Aug. 26	13	Aug. 28	3	Sept. 17	....
	Aug. 27	3	Aug. 29	9	Sept. 18	8
			Aug. 31	8	Sept. 19	1
					Sept. 20	1
Total	.....	56	.....	45	.....	44

Total average mean temperature from August 13 to September 20, 65.68° F.
Total life cycle for the 44 specimens, 30 to 39 days.

TABLE VII.—*Length of life cycle of 4 individuals of Thripoctenus russelli.*

Date of oviposition.	Sign of parasitism.		Parasite larvæ pupated.		Adult emerged.	
	Date.	No.	Date.	No.	Date.	No.
Aug. 14	Aug. 20	4	Aug. 22	2	Sept. 11	2
	Aug. 21	1	Aug. 23	2	Sept. 12	....
	Aug. 22	....	Aug. 24	....	Sept. 13	....
	Aug. 23	1	Aug. 25	1	Sept. 14	1
	Aug. 24	....	Aug. 26	....	Sept. 15	1
	Aug. 25	....	Aug. 27	....		
	Aug. 26	1	Aug. 28	....		
			Aug. 29	1		
Total	.....	7	.....	6	.....	4

Total average mean temperature from August 14 to September 15, 65.96° F.
Total life cycle for the 4 specimens, 28 to 32 days.

TABLE VIII.—*Life cycle of Thripoctenus russelli in Thrips tabaci as a host, September and October, 1911.*

Date of oviposition.	Sign of parasitism.		Parasite pupated.		Adult emerged.	
	Date.	No.	Date.	No.	Date.	No.
Aug. 28	Sept. 4	2	Sept. 8	2	Sept. 29	1
	Sept. 5	1	Sept. 9	6	Oct. 2	1
	Sept. 6	3	Sept. 11	2	Oct. 3	2
	Sept. 8	7	Sept. 12	1		
			Sept. 15	1		
Total	.....	13	.....	12	.....	4

Total average mean temperature from August 28 to October 3, 64.7+° F.
Entire life cycle for the 4 specimens, 32 to 36 days.

To summarize all of the rearing experiments conducted during the summer of 1911, the life cycle of this insect required from 28 to 44 days, but the average was between 30 and 34 days. (See fig. 10.)

FIRST APPEARANCE IN THE SPRING.

In 1911 this insect was not observed until June 15, although a very careful lookout had been kept from early in the spring. Undoubtedly future work will show that this insect becomes active considerably before this time and probably as early as the middle of March at least.

LAST APPEARANCE IN THE FALL.

In 1910 parasitized thrips were found as late as November 10 and after that, although thrips larvæ were collected, no signs of parasitism could be found. In 1911 very few adults emerged from the pupæ after October 1, although adults were observed in the field as late as October 21. On November 10, 1911, a large collection of thrips larvæ gave only 9 parasitized specimens, while a later collection, made December 8, gave one parasitized form, which would indicate that this parasite had about ceased its work.

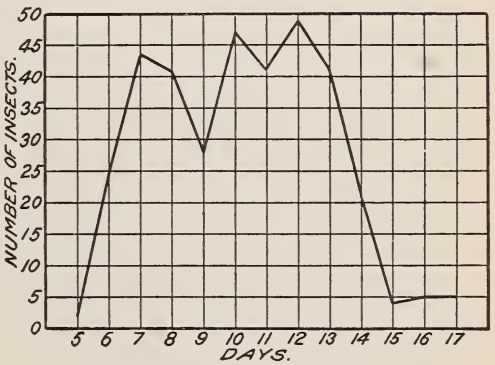

FIG. 8.—Diagram illustrating length of time from oviposition to first evidence of parasitism for 353 individuals of *Thripoctenus russelli*. (Original.)

NUMBER OF GENERATIONS.

The experiments made during 1911 have shown that the female of this insect may begin oviposition in a very few hours after emerging from the pupa. Because of this we can expect a new generation to be begun the same day that the female emerges, provided she finds host larvæ. Therefore, if we take March 15 as a point when this insect becomes active in the spring and November 10 as the date that this insect ceases to oviposit, we might obtain as many as 8 generations, provided each required only 28 days for development, or only 5 generations if the maximum period for development was required.

HIBERNATION.

Thripoctenus russelli passes the winter in the pupal stage, the different individuals evidently hibernating as soon as the temperature drops sufficiently low to check development. Pupæ taken to Washington, D. C., all entered hibernation as early as October 1, while the adults were still emerging at the laboratory in Compton,

Cal. At the latter place many entered hibernation as early as October 5, and after that date very few adults emerged.

OCCURRENCE.

The adult of this insect was first observed in a bean field at Hollywood, Cal., on June 29, 1911. At this time one was noted in oviposition and a careful search of the bean foliage for about 3 hours resulted in the capture of 5 more. On July 18, 1911, Mr. Graf and the writer again visited this field and after a very careful examination collected 12 more adults. On August 4, 1911, a visit to this field resulted in the capture of 7 more specimens of this insect, and on August 18 a prolonged examination produced 1 specimen on a leaf of *Lactuca scariola* and 1 on the leaf of a lima bean plant.

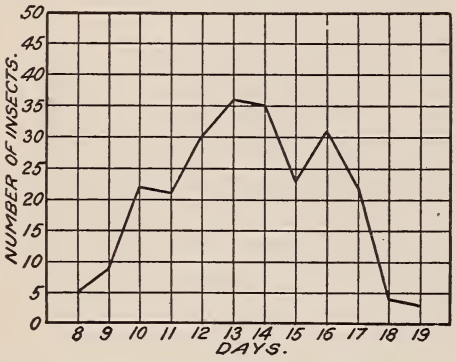

FIG. 9.—Diagram illustrating length of time from oviposition to pupation for 241 individuals of *Thripoctenus russelli*. (Original.)

At Compton, although many parasitized thrips had been collected for over 1½ months, this insect was not found in the adult stage until August 26, 1911, when 1 was taken on a leaf of *Lactuca*. At this time the adults seemed to be very common on turnips in the laboratory yard, for on August 28 Mr. Graf collected 1; on August 29, 1; and on August 30, 2. The writer, on September 1, observed 7 adults crawling over turnip foliage and on September 2, 4 more were observed. Two of these were actively ovipositing in larvæ of *Thrips tabaci*. On September 17 and 23 Mr. Graf observed 4 adults on the turnip foliage.

While Mr. Graf was at Puente, Cal., on October 3, 1911, he found 1 adult of this parasite on a leaf of *Sonchus oleraceus* badly infested by the bean thrips. At the same place on October 21, 1911, Mr. Graf discovered a small bush of *Nicotiana glauca* badly infested by the larvæ of *Heliothrips fasciatus* and careful examination revealed the presence of this insect. On 15 leaves of this plant infested by the bean thrips he found between 40 and 50 adults of this parasite. These were very active and many were observed in oviposition.

DISTRIBUTION.

This insect was first discovered at Compton, Cal., during December, 1910, and during 1911 it has been found to occur very commonly in that locality. During June, 1911, it was found to occur at Hollywood and later it was reared from material collected at Whittier and Puente, Cal. These localities are all situated in Los Angeles County and make up an area of nearly 150 square miles. A few collections

of the host larvæ made at Garden Grove and in Los Angeles failed to show parasitism, but probably more extensive collections would have revealed the presence of this insect in both places. Compton, which is near the coast, has a much cooler climate than Puente, which is more inland, so that this insect appears to thrive along the coast and also in the drier and hotter interior valleys.

PERCENTAGE OF PARASITISM IN DIFFERENT LOCALITIES.

The hosts of this parasite are such delicate insects that in all rearing work many have died from the artificial conditions in the vials. Therefore it is impossible to give the exact percentages of the number of thrips parasitized by this insect or the number of normal forms. Nevertheless some idea may be obtained of the work this insect is capable of doing to check its host, *Heliothrips fasicatus*, in Los Angeles County, Cal. at Compton for 1911.

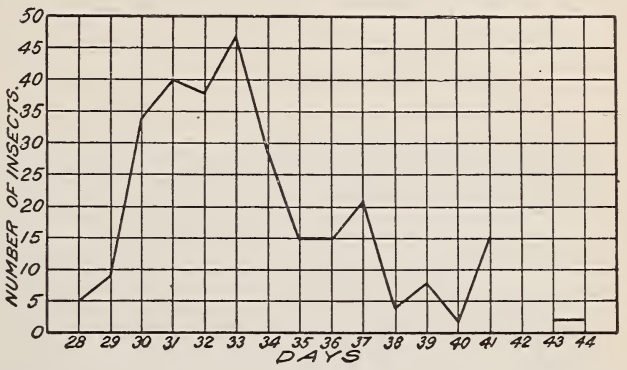

FIG. 10.—Diagram illustrating total number of days in the life cycle of *Thripoctenus russelli;* summary of all rearing experiments. (Original.)

Table IX gives the percentage of parasitism at Compton for 1911.

TABLE IX.—*Percentage of parasitism of Heliothrips fasciatus, Compton, Cal., 1910–11.*

Lot No.	Collected.	Number parasitized forms.	Number normal forms.	Per cent parasitized.
	1910.			
1	Nov. 10	4	20	16.66
	1911.			
2	June 15	1	5	16.66
3	June 29	2	26	7.0+
4	July 6	2	8	20.0
5	July 8	.....	20–30	.....
6	July 10	.....	31	.....
7	July 12	57	12	70.3
8	July 12	.....	5	.0
9	July 14	5	26	16.0+
10	July 17	.....	16	.....
11	July 18	11	.....	10.0
12	July 18	11	.....	7.0
13	July 31	21	.....	15.0
14	July 31	37	.....	25.0
15	Aug. 3	3	.....	3.0
16	Aug. 7	65	.....	50.0
17	Aug. 8	74	.....	45.0
18	Aug. 14	54	.....	40.0
19	Aug. 16	147	.....	70.0
20	Aug. 21	140	.....	[1] 70.0
21	Aug. 26	80	.....	[2]
22	Aug. 28	24	.....	[2]
23	Aug. 30	35	.....	[2]
24	Sept. 2	27	.....	[2]
25	Sept. 4	41	.....	[2]
26	Sept. 6	9	.....	[2]
Total parasitized forms of Heliothrips fasciatus collected at Compton	.....	850	.....	.....

[1] About.

[2] Not determined.

In these collections the percentage of parasitism ranged from 0 to 70.3.

Table X gives the percentage of parasitism at Hollywood. The average percentage for that locality was only 0.78+, which seems very strange, as the adult parasite was frequently collected on foliage at that point. However, this low degree of parasitism may have been due to collections made at times when the parasitized material was pupating.

TABLE X.—*Percentage of parasitism of Heliothrips fasciatus, at Hollywood, Cal., 1911.*

Lot No.	Collected.	Number parasitized forms.	Number normal forms.	Per cent parasitized.
	1911.			
1	June 29	2	34	5.55
2	July 8	11	38	22.44
3	July 8	.....	25	.....
4	July 18	.....	275	.....
5	July 18	.....	142	.....
6	July 18	.....	50	.....
7	July 18	.....	66	.....
8	July 18	.....	250	.....
9	July 18	.....	134	.....
10	July 18	.....	50	.....
11	July 18	.....	150	.....
12	Aug. 4	4	(?)	(?)
13	Aug. 4	.....	40	.....
14	Aug. 18	1	500	.199+
Total	.....	18	1,754	.....
Average per cent for total	.....	.....	.....	.78+

Table XI gives the percentages of parasitism for a number of collections made during August and September, 1911, at Puente. In this locality the parasite was working about as actively as at Compton, and the percentage of parasitism rose as high as 49.5 in one case that was determined.

TABLE XI.—*Percentage of parasitism of Heliothrips fasciatus at Puente, Cal., 1911.*

Lot No.	Collected.	Number parasitized forms.	Number normal.	Per cent parasitized.
	1911.			
1	Aug. 1	70	.....	35
2	...do.....	17	40	29.8
3	Aug. 10	19	(?)	(?)
4	...do.....	1	19	5
5	...do.....	2	(?)	Very small.
6	Aug. 29	132	(?)	(?)
7	Sept. 1	84	(?)	(?)
8	Sept. 6	89	95	49.5
9	Sept. 12	76	(?)	(?)
10	...do.....	71	(?)	(?)
Total	.....	561		

At Whittier the host was not abundant, and the one collection made there on August 29, 1911, of 25 thrips larvæ, developed parasitism in two cases, or about 8 per cent.

MEANS OF COLONIZING THE PARASITE.

Experiments conducted during 1911 between Compton, Cal., and Washington, D. C., have shown that this parasite can be distributed in two ways. Either the material can be collected in the field and shipped direct to the point where its introduction is desired, or the material can be placed in cold storage and thus kept until a more favorable period.

In shipping material direct from the field two methods have been used that give good results. Of these the more promising is to collect material where the parasitism is high and put the thrips larvæ in vials as described under "Methods of collecting for evidence of parasitism" (p. 28). Then, as soon as the parasitic larvæ have

FIG. 11.—Mailing tubes used in shipment of thrips parasites. Original.

transformed to pupæ, they should be packed carefully in cotton, to prevent jarring, and shipped. (See fig. 11.) In the other method the only difference is that the material is shipped as soon as placed in the vials. While this has the advantage of giving more time for shipping, it unfortunately seems to cause greater mortality in the parasitized material. It is also possible to pick leaves of plants infested by parasitized thrips, and pack these in cigar boxes and ship direct. However, this method has not given as good results during the past year as the other two methods.

During the fall of 1911 much material was placed in cold storage in Los Angeles. In these experiments parasitized prepupæ of the thrips were placed in vials or in rubbish and then put in either the

egg room or the fruit room. In the same way parasite pupæ were also placed in cold storage. In the egg room the temperature is kept at 31° F. and the air is dry, while in the fruit room, while the temperature is the same, the air is rather moist.

From these experiments it seems that the parasitized prepupæ are able to stand exposure in cold storage for at least 41 days, and when removed at the end of that time the parasites will change to pupæ.

Likewise, when parasite pupæ are placed in cold storage, the period of emergence of the adult may be retarded for a time until conditions are more favorable for its propagation. In these experiments pupæ were left in cold storage for 41 days and then put in a cool greenhouse and in 79 days the adults began to emerge.

The methods of shipping insects and placing them in cold storage just described are at the most very imperfectly worked out, and it is purposed to experiment along these lines until the behavior under these conditions shall be as completely known as is necessary.

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L. O. HOWARD, Entomologist and Chief of Bureau.

MISCELLANEOUS PAPERS.

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